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FOREIGN TRADE.

The past fiscal year, 1903-4, has been that of the largest foreign trade in the history of the United States. The total commerce of the period was valued at $2,451,574,623, as compared with $2,445,860,916 in the previous year. In manufactures exported the year reached also the highest record, the gain in eleven months over 1900, which held the previous record, being $17,000,000. The excess of all exports of manufactures and agriculture over all imports was $470,084,455. In these figures, or in any aspect of them, we fail to find any sign or note other than hopeful and encouraging. During at least one month the export of manufactured produce was larger than that of agricultural produce. It will probably be a long time before that is repeated, or before this country has reached the stage at which its own population will consume all the food and fabric production, leaving none for export in crude bulk. But it is not altogether wild to look forward to the distant time when virtually all the exports of the United States will be of a manufactured nature. Some people say this country can support 800,000,000 people. It now has eighty. When the larger population is here, domestic and international politics and tariffs will be slightly different from what they are now. In all this growth and intercommunication, electricity has a mighty part to play.

BUSINESS EFFICIENCY AND FAN MOTORS.

A little episode that occurred under our observation the past week during the hot weather attested the value of the humble fan motor in maintaining and enhancing business efficiency. A young lady overcome by the heat in an office where there was no fan motor was quickly revived by the application of the breeze of one brought in from an adjoining office. This was excellent, but the workers in the office deprived of its fan began very soon to suffer, and it was not until another fan motor not in use elsewhere had been installed for them that they were able to resume work and clean it up with dispatch. The consideration of the fan motor as a luxury is not unusual, but we believe it still to be far from common to put it alongside the typewriting machine or the copying press or the telephone as a real and powerful agency for expediting affairs and for keeping individuals and office staffs up to the normal pitch of accomplishment during the long term of summer enervation. On this basis the small cost of the fan and of the current to operate it shows a large margin of profit. It is perhaps late in the day to be talking about the virtues and merits of fan motors, but there remain a great many hot offices and stuffy rooms into which they might be introduced with incontestable advantage.

TROLLEY CAR WIRING.

The Underwriters' National Electrical Association has undertaken important and necessary work in its rules published recently in a separate bulletin on car wiring and equipment, as the result of the conference held under its auspices, with street railway association officials and other authorities. The trolley car, in its process of evolution and improvement, has unavoidably remained an assemblage of inflammable material, but the rules now formulated should serve as a basis for securing greater safety from fire and in the near future should reduce danger to a minimum. There have been altogether too many fires and disasters, and conceding that very often passengers have been unduly alarmed, the fact remains that if the fuse had not blown, or the wires had not got short-circuited, or the heaters had not been improperly used, there could have been no panic.

The rules are strong in their emphasis on metallic sheathing, and are also hearty in their approval of metal conduit. At the same time they permit other practices and materials, under due safeguard, and it will be interesting to note in this respect how, as time goes by, the use of wood is adhered to or becomes finally subject to severe limitations, in new cars. The treatment of car cables, switching cabinets, fuse boxes, etc., is also a topic in regard to which improved or more rigid rules are likely to come into vogue, especially when the cars are used underground. In general the rules are admirable, but they would be greatly benefited by the exclusion of such phrases as "is strongly recommended," "attention should be given," "should never be," "it is not expected that old equipments will be rapidly brought up to this standard," "should be avoided where possible." Such utterances are weak-kneed, and insurance rules should be as firm in their prohibitions and fiats as the Ten Commandments.

GROUND SHIELDS IN TRANSFORMERS.

In one of the papers read before the American Institute of Electrical Engineers at its June meeting in Chicago, by Mr. J. S. Peck, the advantages and disadvantages of ground shields in transformers is discussed. The general conclusion of the paper is that in all transformers to some extent, and particularly in large transformers, the grounded conducting shield between the primary and secondary windings does not convey adequate protection without marked additional expense. It is suggested that a cheaper and better substitute for the ground shield is a grounded secondary circuit. The above conclusions appear very sound. It is not as though the ground shield within the transformer dispensed with the inconvenience and expense of establishing a reliable ground connection on customers' premises. Whether a grounded shield or a grounded secondary circuit is used, the ground has to be made near the transformer, on installation.

If the ground wire is properly connected to the secondary circuit, a permanent and reliable protection for the latter should be secured. If, in order to secure insulation for the secondary circuit, a grounded shield is interposed, extra insulation must be used and valuable space sacrificed to the detriment of the transformer's behavior. From every standpoint a permanently grounded secondary circuit seems preferable. Moreover, as the paper points out, even if the ground shield may be regarded as forming a perfectly reliable safeguard against accidental crosses between the primary and secondary circuits within the transformer, it is powerless to protect against crosses between the primary and secondary circuits occurring in the leads emerging from the transformer, or in the neighboring wiring. There can be no doubt, however, that the proper point at which to ground a secondary circuit is the neutral point of the transformer secondary winding.

N. E. L. A. QUESTION BOX.

One of the most interesting and instructive features of the convention in Boston of the National Electric Light Association was the "Question Box," to which every member was invited to contribute either a question or an answer on some point involved in his own particular line of work. The answers which have been given in the bulky volume just issued can, therefore, be considered as coming from men tutored in the school of experience, and they are specially valuable in many cases on that account. The questions and answers cover all classes of electrical equipments from the prime-movers to the lamps themselves. A few of the practical points obtained from experience with electrical machines are given below, as interesting and typical.

In regard to the operation of 60-cycle, double-current generators for lighting service, it is stated that, while the design of such machines involves some difficulty, experience shows that where the load is steady on the alternating-current side, satisfactory results are obtained. The three-wire dynamo equipped with one commutator and balancing coil has been found in practice to stand unbalancing of load to the extent of 25 per cent. on the two sides of the system. The use for crane and hoist work of alternating-current motors supplied from lighting circuits has proved satisfactory only in cases where automatic regulators have been installed. In the operation of passenger elevators from a three-phase, alternating-current system, satisfactory service demands that resistance be used in the secondary circuit of the induction motors, or that the motors be mounted with clutches and shifting pulleys. The cost for maintenance of induction motors is stated to vary from nothing for three years' service to three-fourths of that for direct-current motors. Induction motors have proved to be equally as efficient as the direct-current machines for derrick hoists, and the results as to delicacy of control obtained by their use have been slightly favorable to the alternating-current motors.

Of the relatively recent types of central station auxiliaries, automatic potential regulators now upon the market have given excellent service on lighting circuits, and time-limit circuit-breakers with relays of the bellows or diaphragm type have proved quite satisfactory. It is, after all, in central station practice and the hard school of wear and tear that even the best and most promising theories and appliances must attest their utility and prove their own longevity. The Question Box of the N. E. L. A. in this respect is a very useful institution. Some of the things recorded might be left out and the book could be smaller without harm, but even the naïvest and most foolish confidences have their value, and if no questions are asked it is all the harder to ascertain how a thing strikes the other fellow.

THE TROLLEY EXCURSION SEASON.

This is the time of year when trolley lines adjacent to green fields and blue seas get a good deal of excursion traffic, some of which is wisely catered for, and much of which is still in a very unsatisfactory stage of development. Recent episodes in Brooklyn have not been altogether of a reassuring nature, and a complaint that reaches us this week from a reader in New England with a lively turn for satire emphasizes a few points of discomfort and discouragement. As discussion is always a helpful element in such matters, and as the topic may not be quite so fresh next January, we feel that space may now be devoted in reviewing briefly our correspondent's woes.

To begin with, lured by attractive descriptions, he boarded a car at Smithville on the Dogfish Cove route, and by great agility managed to get a seat between a worthy Teuton, who had been eating onions, and an estimable colored citizen in his sweaty shirt sleeves. He is democratic and did not particularly mind this first stage of twelve miles over a mouldy sort of meadow to Pupsley-by-the-Sea, at which place is a change of cars not suggested on the programme, and a wait of fifteen minutes in a dusty street, not included in the five hours of running time. Our friend was fortunate enough to find standing room on the rear platform and ride there for an hour, during which time four fares are collected. The next stage, from Sludgewater onward, found him, after twenty minutes' wait, entrenched on one square foot of running board. Suffice it to say that he reached Dogfish Inn after six changes of cars, in just six hours and forty-seven minutes, shortly after the dining-room doors had closed. Visions of a cooling plunge in the surf have vanished, and after a macadamized sandwich in the alleged café, and a hasty

examination of time tables, he catches an express train and reaches home at seven-thirty, badly wilted, but put wise.

Now, allowing for the obvious exaggeration of such a very true story, the solemn truth of the whole matter is this: that useful and convenient as trolley systems are, many managers have yet to learn the first rudiments of doing a through business. On local work they are successful enough, but when it comes to long runs they are in precisely the disorganized or unorganized condition of the steam roads more than half a century ago. It is not a case to be helped necessarily by consolidation, for the Smithville-Dogfish Cove line is already under a single so-called management. It is apparently a case of neglected opportunities and failure to grasp the needs of through passenger traffic, as such. With proper accommodations that line could easily increase its earnings by a couple of thousand dollars a day during the heated term, but under present conditions long-distance traffic is steadily repelled. To make the really great electric car systems of the fullest public usefulness, and, what is more to the point, of the maximum earning capacity, it is necessary to cultivate not only the local business but the through business. An intercommunicating system is of small importance if used as an aggregation of local roads and not as a unit.

The one thing of first importance in dealing with long electric lines is a regular scheme for through cars, so as to avert the necessity for changes entirely, or at least to reduce changes to a minimum. Changing cars especially in face of a heavy local traffic repels long-distance passengers and drives them over to the steam roads. With through cars run as extras during the crowded season, a very profitable business could be built up, at comparatively small expense. Some increase in rolling stock would be required, but the feeding systems and power plants are, as a rule, capable of dealing with the required increase of output when properly planned. Even in cases where the roads concerned in a long run are under different managements, it would generally be possible to arrange for track rights on reasonable terms, as is frequently the case in steam railway practice. It really is needless to argue the matter, for the whole field has been threshed over for fifty years. The American is by nature a traveler; he makes nothing of long trips in these days; but he has been educated up to this point by the efforts of several generations of astute and tactful passenger agents. If one could not buy through tickets to St. Louis, but had to change cars a dozen times between that city and New York, New Orleans or San Francisco, with no method of sending ahead for accommodations, how many visitors would go to the Exposition? On a small scale these disjointed conditions are repeated on many of the trolley systems. Their effective competition with steam roads, save over very short distances, depends on the extent to which increased convenience and comfort can be made to compensate for decreased speed. Particularly is this true with respect to riding for pleasure. A man has to ride to his work and the trolley company gets his nickel anyhow, but he does not have to slip down to Dogfish Cove, and will not try it at all unless he is sure of a reasonably comfortable trip.

ARITHMETICAL VERSUS PHYSICAL VECTORS.

In this issue, on page 133, will be found an able article by Prof. Eddy upon a much vexed question concerning the multiplication of vectors. We are all so accustomed to the operations of ordinary arithmetic, in which we were grounded at school, that we are apt to look upon our arithmetical conceptions as intuitive or innate. It is only when the history of arithmetic is examined into that we realize how slowly the ideas grew which are now so familiar and how many efforts, working lives and centuries of race development have been necessary to bring about existing methods of ordinary arithmetical computation. Arithmetic, as generally understood, is barely seven hundred years old among European nations, because the Arabic notation only came into vogue about that time ago, and prior thereto only the Roman numerals were known. Fractions, even vulgar fractions, developed slowly one or two centuries later, and decimal fractions are of relatively recent general use. They are rarely seen in books over one hundred years old. The science of arithmetic has been gradually moulded in such a manner as to be consistent with itself on the one hand, and consistent with human experiences in the visible universe on the other hand.

Complex numbers, of the type $(3 + 5\sqrt{-1})$ have, in the past few decades, come to be regarded as included, by extension, within the province of arithmetic. There are many arithmetical problems that can only be correctly answered by such complex numbers. These complex numbers are capable of being represented by points on a plane, and, under that interpretation, are sometimes called plane vectors. Such vectors, as geometrical illustrations of complex arithmetical quantities, are subject to all the rules of arithmetic. In particular, if two plane vectors, considered as complex numbers, are multiplied together, their lengths are multiplied to form the length of the new vector product, and their position angles are added to form the new position angle. Consequently, if the position angle of either factor is arbitrarily altered, the relative direction of the product in the plane is likewise altered.

But mathematics include much more than arithmetic; or, expressed in another way, arithmetic is but one branch of mathematics, which purports to cope with all possible or conceivable quantitative relations. The quantitative relations of mechanics, or of physics, must be provided for by mathematics consistently with our experiences of those departments of natural law. The product of the speed of a rifle bullet into its mass is defined as the momentum of the bullet; and the laws of momenta might, conceivably, vary from the laws of purely arithmetical products. It would not be impossible to have one kind of arithmetic for numbers, another kind of arithmetic for mechanics, a third for electrics, a fourth for magnetics and so on. That is to say, it does not necessarily follow that the laws of mere numbers and their various operations should be precisely similar to the laws of quantities of matter, or to the laws of physics.

Up to the present time, only one other arithmetic besides that of ordinary numbers has been considered of sufficient importance to be learned by scientific students, and that has been called quaternions. It might also be called the arithmetic of mechanics or physics. It treats specially of vectors or quantities that, like forces, essentially possess direction in space, as well as magnitude. It is quite clear that the product of two physical vectors, such as a force and a distance, must be defined in such a manner as not to be subject to change by any change in the directions of reference, or co-ordinate axes, adopted to assist in carrying out the process. It is mainly owing to this necessity that the operation of multiplication in the new arithmetic of mechanics differs from the operation of multiplication in the ordinary arithmetic of numbers.

In the case of the arithmetic of the alternating-current circuit, Prof. Eddy virtually shows that when an alternating e.m.f. operates upon a circuit having a known admittance, this admittance may be regarded as merely a complex number, and the current in the circuit is found by multiplying the vector e.m.f. by the complex numerical quantity admittance; and then regarding the result as a vector current. If, however, we attempt to multiply a vector current by a vector e.m.f. we enter the domain of physical arithmetic as applied to vectors, and the result is properly subject to a different law of operation.

Standardization of Enclosed Fuses.

In order to overcome the difficulties due to the lack of uniformity of sizes and ratings of the various enclosed fuses now upon the market, and to be able to suggest to manufacturers proper details of construction for obtaining the most satisfactory dimensions in securing interchangeability of the fuses for any given capacity, a committee of the Underwriters' National Electric Association has been collecting information regarding the enclosed type of fuse from manufacturers all over the country and has been conducting a series of tests to determine experimentally the advantages of certain constructive features.

Through co-operation with the Edison Illuminating Company, of Boston, and the Boston Elevated Railway Company, tests were conducted in the large power stations of these companies to ascertain the operation on short-circuit and otherwise of fuses of very large capacities, at 220 and 550 volts. The tests were so arranged that the fuses were subjected to conditions equivalent in all respects to those which obtain in any large system. As a result of the information obtained from the manufacturers and from the tests, the committee has recommended certain standards which are about to be adopted by the National Board of Fire Underwriters.

According to the recommendations, the ferrule type contact clip is to be used for all sizes not exceeding 60 amp. and for all voltages up to 600, while for currents from 61 to 600 amp. the knife blade contact type is required. The length of a 200-amp, 250-volt fuse is to be 4.5 in. between clips, while a 200-amp., 600-amp. fuse is to be 7 in. The results of such free and friendly co-operation between the underwriters, the manufacturers and the users of electrical devices should be greatly beneficial to all electrical interests, and the securing of a standard in fuse dimensions at this time will be a distinct step in advance.

Transformer Litigation.

Judge Coxe, of the United States Circuit Court for the Northern District of New York, has rendered a decision in a motion for a preliminary injunction in a suit involving the Stanley transformer patent of March 1, 1892, which patent was sustained in the same court in the so-called Saranac case. The court held that if the defendant in his transformer uses a length of wire substantially equal to the length of the wire prescribed by the Stanley patent, the question of infringement must be determined in favor of the owner of the patent. As to the defence that the method described by Stanley was previously shown by Zipernosky and Deri, it is stated to be sufficient to say that the court of the same circuit had decided that it was not anticipated by the Zipernosky and Deri publication. While it is not pretended that the length of wire on the defendant's coil was ascertained by application in each instance of the Stanley rule, yet it is established that the length required by that rule is, approximately, used by the defendant.

The tremendous advance in the electrical art during the 18 years since Stanley's invention has placed in the hands of electricians means for ascertaining the correct length of the wire on the primary coil more expeditiously and accurately than those pointed out in the patent, but it was held that this does not enable them to appropriate the invention, and they cannot use the Stanley length of wire because modern methods have enabled them to secure that length without applying the tedious and comparatively primitive method of the patent.

The court in summing up held, first, that Stanley made a valuable invention; second, the patent is described in the invention with sufficient clearness to enable skilled electricians to practice it without difficulty; and third, the defendant has appropriated the invention, although its transformers were not designed in the manner pointed out by Stanley. These conclusions, the court considered, rendered it unnecessary to follow the experts into the realms of speculation, even if the court were sufficiently versed in electrical science to enable it to reconcile their numerous disagreements. Stanley's contribution to the art should be judged by the conditions existing when he made his invention over 18 years ago. It is unfair to belittle that invention by comparing his crude recommendations with the scientific methods which have been discovered since that time. His invention remains unchanged, but experience has substituted improved methods of carrying it out. The defendant uses transformers constructed by the improved method, but they are none the less the transformers invented by Stanley. The motion for a preliminary injunction was granted.

The parties to the suit were the Westinghouse Electric & Manufacturing Company and the Montgomery Electric Light & Power Company, a Wagner transformer being the alleged infringing apparatus.

Weston Instrument Litigation.

Judge Wheeler, of the United States Circuit Court for the Southern District of New York, on July 12 handed down an opinion sustaining a claim of infringement of a patent (No. 392,387) granted to Edward Weston under date of November 6, 1888, the defendant being the Empire Electrical Instrument Company. The patent in suit is the fundamental Weston instrument patent, and is the same which was upheld last March by Judge Wheeler in another suit. The patent covers broadly the Weston type of instrument, namely, one with pivoted coil, permanent constant field, damper, etc. The defence of the suit was that at the same date the same inventor took out a similar patent (No. 392,386), applying to ammeters. The judge held that as the patents were simultaneous there was no abandonment of what was discovered in either by description in the other; and no priority in either to prevent a grant by the other if both in any parts covered the same thing, and this they do not appear to do. Each patent, it was held, is for a separate invention, and neither affords any excuse for infringing the other.

Telephone and Telegraph Service in Gambling Resorts.

It would appear that the recent energetic raids by the police on the telegraph and telephone connections between race tracks and pool rooms in New York City have not been so altogether decisive as at first appeared. This week, on the application of Maurice Meyer and Daniel Reilly, Justice Giegerich, of the New York Supreme Court, granted an order to show cause why a mandatory injunction should not be issued to compel the New York Telephone Company to supply service to the New York & New Jersey News Distributing & Circulating Company, which was raided on May 20, when twenty-two alleged poolrooms were entered simultaneously by the police in various parts of the city. Thirty-two telephones and three telegraph instruments and a number of racing sheets and cards were found by the officers in the distributing company's office and confiscated.

It would seem that the company is now desirous of resuming its business of distributing news. The complaint states that the plaintiff is a corporation organized under the laws of New Jersey and has complied with all requirements of the law so as to authorize it to carry on and transact its business in the State of New York; that it has its principal places of business in the Park Row Building, and that it is engaged in the business of distributing and circulating news and information to individuals and corporations for a money consideration. The complaint goes on to state that the defendant is the only corporation able to furnish telephone service in the city, and that prior to the commencement of the action the defendant entered into thirty contracts with the plaintiff, whereby it agreed to furnish telephone instruments and telephone service for the period of one year. Until May 20 last the defendant gave telephone service to the plaintiffs.

On that date the telephone company ceased to furnish its service to the plaintiff under the contracts, and has ever since, according to the complaint, in violation of its agreement, refused and neglected to give any telephone service to the distributing company, although frequently requested to do so. The complaint adds that the failure and refusal to render telephone service is irreparably injurious to plaintiff's business, and threatens to destroy the same, and the plaintiff has no adequate remedy at law, and, therefore, invokes the equitable powers of the court.

Mr. Meyer informed the court that Justice Gaynor, in Brooklyn, had decided that the business of his clients was a legal one, and was entitled to all the rights of an incorporated company.

A Hydro-Electric Power Development on the Catawba River, Near Rock Hill, S. C.

THERE has just been completed at India Hook Shoals, on the Catawba River, at a point about six and one-half miles from Rock Hill, S. C., what is probably the most complete and certainly one of the most interesting hydro-electric developments in the South. The plant was installed to supply electric power to cities and towns within a radius of some 18 miles. The drainage area for the hydraulic equipment is about 3,000 square miles, with annual precipitation of about 50 in. A minimum flow through rainfall for the four seasons of the year averages 2,100 cu. ft. per second. This flow, according to Government records, was about 1,500 cu. ft. per second, but subsequent weir measurements taken over the crest of the dam justify its being placed at the above figure.

An effective head of 22 ft. of water in the dam, guaranteed under the severest of conditions, and a flow of 3,619 cu. ft. per second, gives a gross output of 9,033 hp, or, at an efficiency of 66 per cent., 5,962 net hp. For nine months out of the year an amount of power equal to 7,611 hp is available for the day run of 12 hours and 1,000 net hp for the 12-hour night run, permitting the sale of secondary power for the nine months of 1,649 hp for the 12-hour day run. The entire length of the dam is 1,266 ft. and of the spillway 585 ft. The impounding structure of the plant consists of a masonry-core earth dam, the power house acting by virtue of its position as masonry dam and retaining wall for the forebay.

The power house, with its foundations of granite masonry, is honeycombed with arched openings for the housing of the various machines and for affording entrance and exit for the water. In this section there are eight bays. The bay nearest the spillway, the penstock of which serves both the large power unit and one exciter, is built to more ample dimensions than the others, which are identical in all respects. In each penstock is located a water wheel unit composed of three 54-in. special pattern Hercules turbines mounted on horizontal shafts and having a total capacity of about 2,100 hp. The efficiency is guaranteed at 80 per cent. from ¾ to full gate, under a 25-ft. head, each turbine using approximately 15,000 cu. ft. of water per minute at 110 revolutions. The present installation consists of but six units of water wheels, only the quarter-turns, bulkheads and draft tubes of the two additional units having been erected.

The power house is a brick structure with slate roof and supported by steel trusses, forming a light, airy housing for the generators and accessory machinery. The complement of electrical apparatus is of the newest and latest pattern. The generators are three-phase, 60-cycle, alternating-current machines, with capacity of 750 kw. They are of the revolving-field type and generate current at 11,500 volts, with speed of 300 r.p.m. The rated full-load current of each three-phase generator at a normal potential of 11,500 volts is 37½ amp., there being required to excite the field at full non-inductive load a current of 75 amp. at 95 volts, the maximum exciting capacity under a 25 per cent. non-inductive overload being 15 kw. These machines are guaranteed to run for 24 hours continuously at 25 per cent. overload at 11,500 volts without excessive rise in temperature. Following are the guaranteed efficiencies, including friction: Full load, 94 per cent.; three-quarter load, 93 per cent.; one-half load, 90½ per cent.

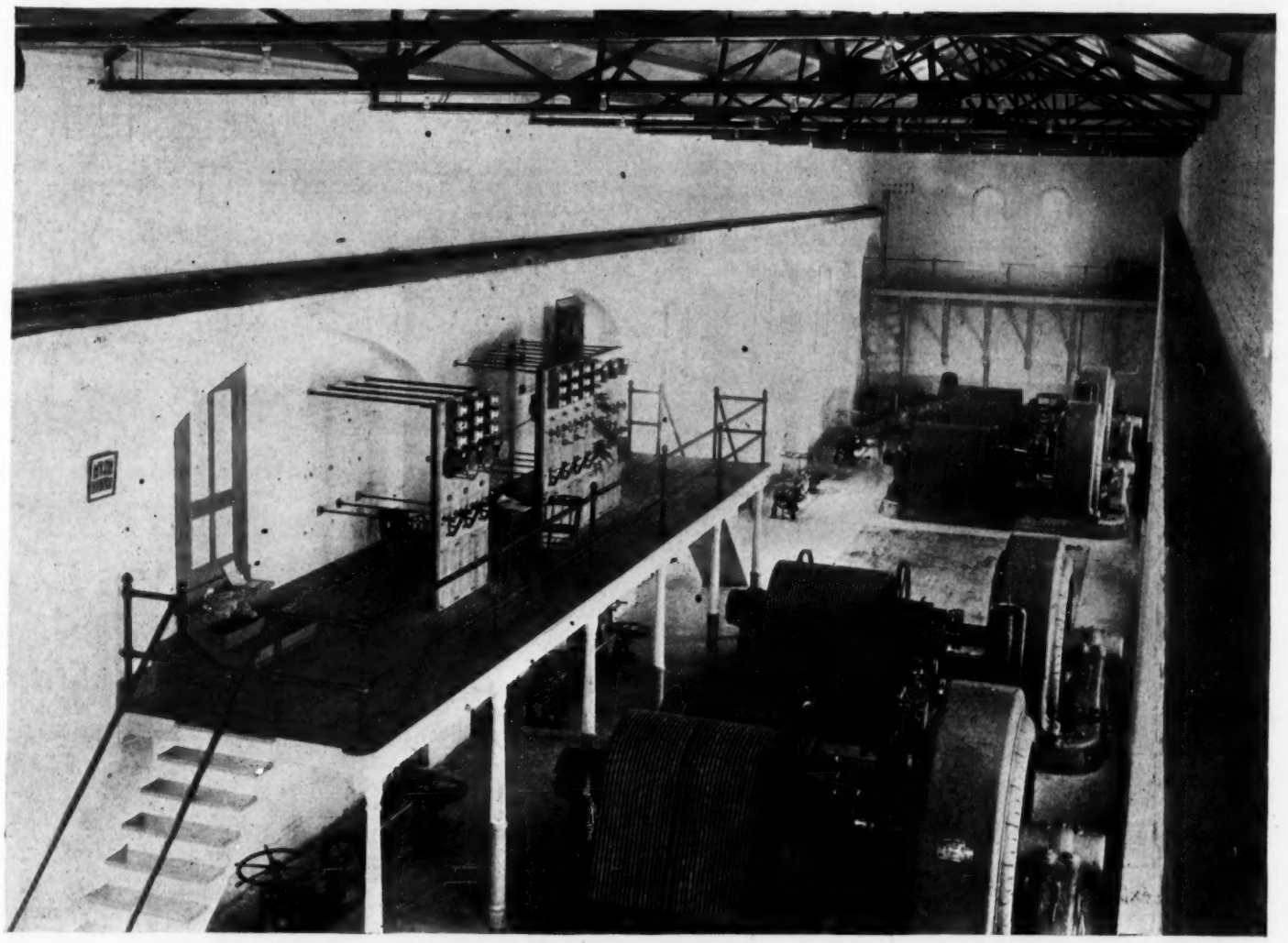

FIG. 1.—SWITCHBOARD AND MACHINES OF PRESENT INSTALLATION.

Four generators, with space for the installation of four additional machines, constitute the present equipment. Connection with the water wheels is effected by means of a rope drive of the American type, each machine having two sets with 16 wraps of 1½-in. Manila rope. The driver has a pitched diameter of 13 ft. 10 in. and revolves in a water-tight pan to protect the ropes against any water finding its way into the pulley pits. The rope speed at the rated machine speed is about 4,780 ft. per minute, and tension is maintained by means of a weighted idler sliding on tracks and mounted at an angle with the drive. This idler also serves to feed the rope across the driving pulleys. The floor of the pulley pit is of concrete-steel construction. Leakage into it is removed through drains and by means

of a 3-in. by 4-in. triplex power pump driven by belt from the water wheel shaft.

Two exciter units have been installed, with capacity sufficient to excite the complete installation of eight alternating-current generators, and to supply current for the lighting of the power house. The turbine installation consists of two 27-in. Hercules water wheels mounted on vertical shafts and capable of producing 170 hp under a working head of 25 ft. The same guarantee of 80 per cent. is made for these wheels as for the 54-in. wheels. Through a pair of mortice bevel gears a direct connection is formed between these wheels and a jack shaft, the latter being connected by link couplings to the shafts on which the generators are mounted. The wheels are controlled by cylinder gates operated from the floor of the power house. The electrical equipment of the exciter plant consists of two direct-current, 6-pole, 115-kw, compound-wound generators running at a speed of 450 r.p.m. and generating 125 volts. At a normal potential the rated full-load current of each of these exciters is 920 amp. and the machines are guaranteed to operate for one hour without movement of the brushes and without injurious sparking. Following are the guaranteed efficiencies without friction: Full load, 91 6/10 per cent.; three-quarter load, 90½ per cent.; one-half load, 87½ per cent.

A flange coupling is used for connecting these two units, or either exciter may be operated from one of the wheels separately. The switchboard is mounted on a gallery overlooking the machines. By its use all generators may be operated in multiple on three feeder circuits and also the operation of any generator or set of generators separately on any feeder may be accomplished. The oil switches permit of the opening of the generator or feeder circuits under load. The switchboard is of the low-voltage type, all high-tension apparatus being out of reach of the attendants in a separate apartment off from the main room. The board consists for the present installation of ten panels on which are placed all necessary controlling and indicating devices. Of these panels four are for the generators, each containing one load ammeter, one field ammeter and one voltmeter, the instruments being of the horizontal, edgewise type. They contain also the operating handle for the oil switch and synchronizing device, this latter device consisting essentially of a voltmeter in connection with lamps and a receptacle on the panel, which makes such connections as to enable the use of the voltmeter either for synchronizing or for normal voltage reading.

Corresponding to this equipment there are mounted for each panel in the high-potential room a current transformer, two potential transformers, three single-pole, non-automatic, form K General Electric oil switches in soapstone compartments. These switches in these compartments are operated mechanically by means of rods and belt cranks from the switchboard. These devices are designed to rupture loads which under emergency conditions cannot exceed 6,000 kw at 13,000 volts for the three-phase circuit. For connecting the bus-bars there are also six single-pole, single-throw knife switches mounted on a platform above the compartments containing the transformers and switches. In each of the two exciter panels are contained one 1,200-amp. ammeter, a rheostat, a potential receptacle, two 800-amp., single-pole, single-throw lever switches with fuses on the rear of the panel. One of the panels also contains the device for the electric control of the governors. The exciter feeder panel contains one 175-volt voltmeter, two 50-amp. lever switches for station lights and six double-pole, single-throw field switches with discharge resistances. There are three alternating-current feeder panels, each containing three ammeters, a Thompson polyphase recording wattmeter, the operating handle for the automatic oil switches and the overload relay for the oil switches, the relay being operated by direct current from the exciters. For this equipment there are mounted in the high potential room two current transformers for wattmeter and ammeters, two potential transformers for the wattmeter, two current transformers for the oil switch and six single-pole knife switches for connecting the bus-bars. In addition two equalizer pedestals have been furnished for the exciters. The single-pole switches on generator and feeder panels are arranged to permit of connecting the generators and feeders to either or both sets of bus-

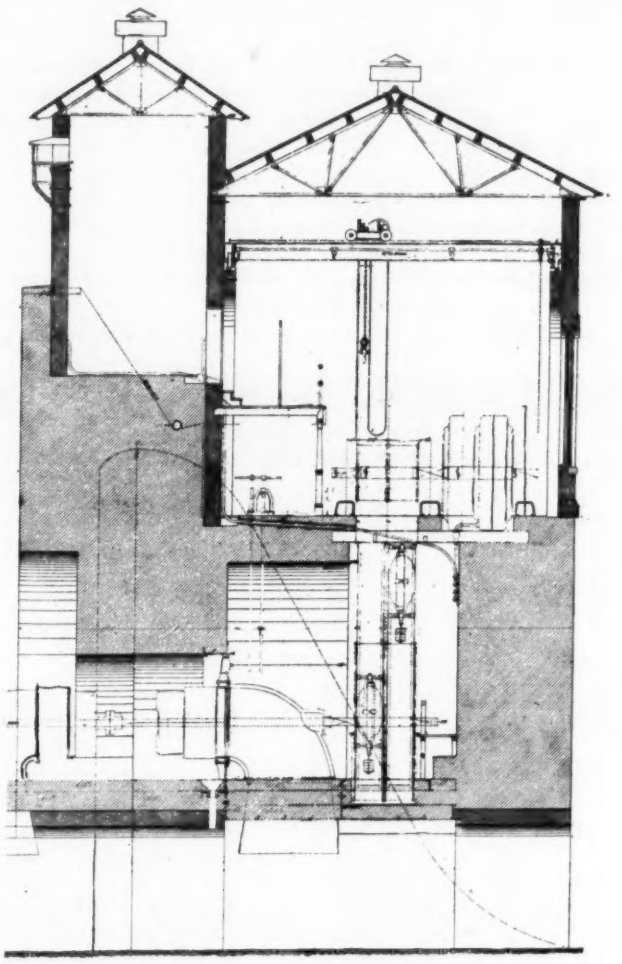

FIG. 3.—CROSS-SECTION VIEW OF POWER PLANT.

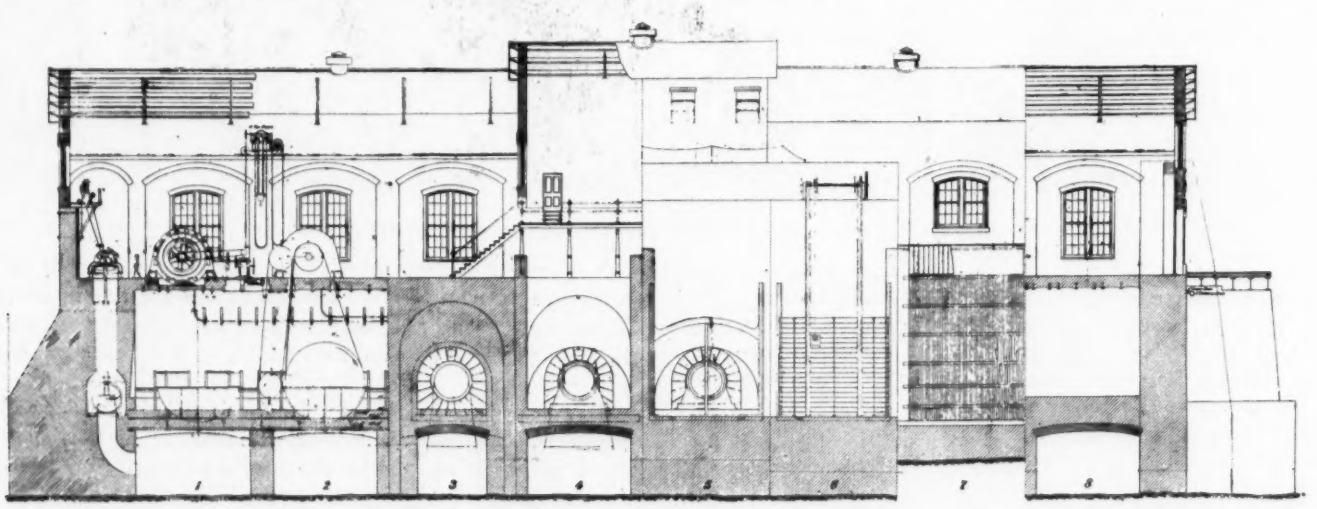

FIG. 2.—LONGITUDINAL SECTION OF POWER PLANT, CATAWBA RIVER.

bars. Lightning protection is provided by fitting each end of each wire with a 13,000-volt bank of lightning arresters having porcelain barriers. Tile pipe 4 in. in diameter carries all cables beneath the floor with the exception of the generator leads, which are carried on brackets along the side of the pulley pit.

der, unlike other types, is placed vertically instead of horizontally, effecting a great saving in space. They are electrically controlled from the switchboard. Continuity has been sought by building the entire plant to withstand the utmost strains which may be imposed upon it, while the transmission lines were designed with a view to

FIG. 4.—FIRST WATER OVER SPILLWAY.

Power is at present being furnished to three points: Rock Hill, S. C., 6½ miles; Fort Mill, S. C., 3½ miles, and Charlotte, N. C., 18 miles, and in the construction of the lines the two requirements of a successful long-distance transmission, continuity and regulation, as suggested by Mr. F. A. C. Perrine, in a paper read before the

the greatest permanence. The poles are of cypress, juniper and chestnut, 35 ft. long, 14-in. butts, 7-in. tops and are buried in the ground a distance of 5½ ft. The ground ends have been liberally coated with coal tar. The cross arms are of long yellow leaf pine painted two coats, the pins being boiled carefully in paraffine. On the Rock

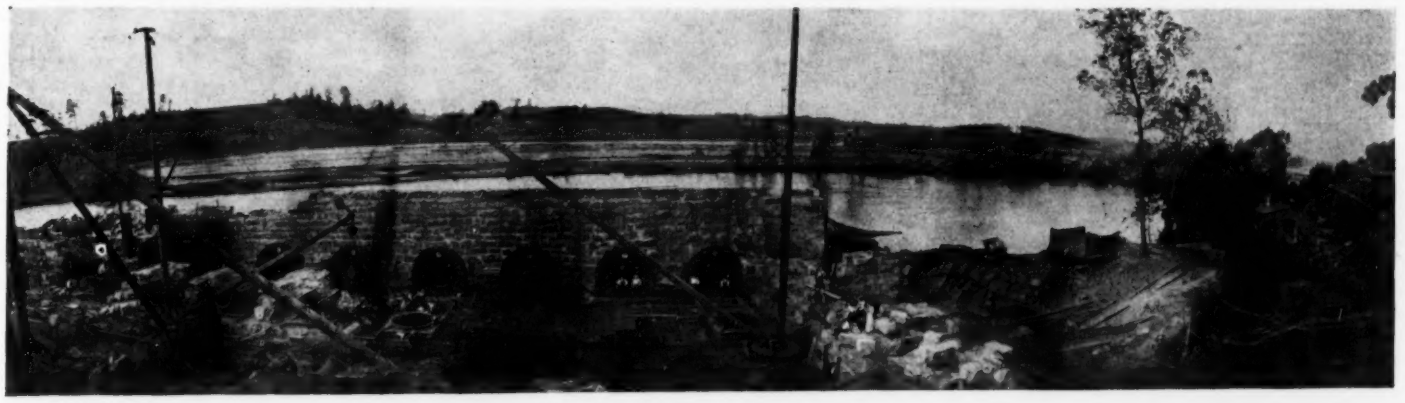

FIG. 5.—SETTING OF THE HYDRAULIC PLANT.

Boston Society of Arts, have been kept well in mind. The design of the generators provides for the regulation, as there is a guarantee on the machines that the inherent regulation will not exceed 6 per cent., and that at 90 per cent. power factor and 37½ amp. at 11,500 volts, the regulation will be within 15 per cent.

Hill line for a distance of six miles, the poles are spaced 100 ft. apart and are to carry two circuits, each of three wires spaced in form of an equilateral triangle with 24-in. legs (Figs. 3 and 4). No. 1 and No. 2 Imperial porcelain insulators were used indiscriminately. These insulators are of the one-piece, triple-petticoat pattern. No. 1 is 6 in.

FIG. 6.—CLOSED GATES AND POWER HOUSE, FROM FOREBAY.

Two of the new type N Lombard governors are used to control the speed of the alternating-current generators, two generators being connected in parallel and controlled by one governor. These governors are driven by belt from the generator shaft, being connected by wire cable to the water wheel gate. The governor develops approximately 30,000 foot-pounds on the gate rigging. The hydraulic cylin-

in diameter and 4 in. high and stands a test of 45,000 volts. No. 2 is 5 in. in diameter, 3⅞ in. high and stands a test of 40,000 volts. Being of a dark color they are not likely to attract the aim of small boys with rifles. They are mounted on 1½-in. locust pins, 11 in. long and carry No. 0 hard-drawn bare copper wire tied with No. 10 wire. The transmission circuits will carry the finally contemplated

3,000-hp output with a line loss not exceeding 10 per cent. A barbed wire for lightning protection is carried on special brackets and supported on pony insulators along the top of the poles, being grounded wherever good ground could be obtained. A metallic circuit telephone line is maintained 15 ft. above the ground and at a distance of 11 ft. from the high-potential circuit. This circuit consists of No. 12 B. B. galvanized-iron wire transposed every third pole, and is giving satisfactory service. A weather-proof wire is used within the city limits.

The transformers are of the oil-cooled type, wound for 11,000 volts primary circuit and either 2,200 or 550 volts secondary circuit. At all points where consumers have tapped the line, or where transformers have been installed, danger of interruption has been minimized by the use of automatic oil switches with lightning arresters.

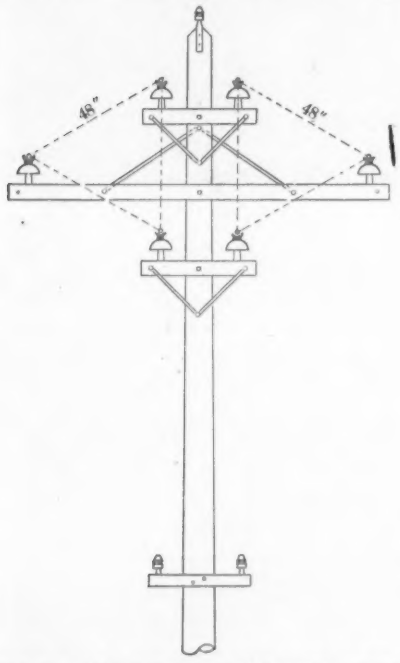

FIG. 7.—POLE TOP FOR 22,000 VOLTS.

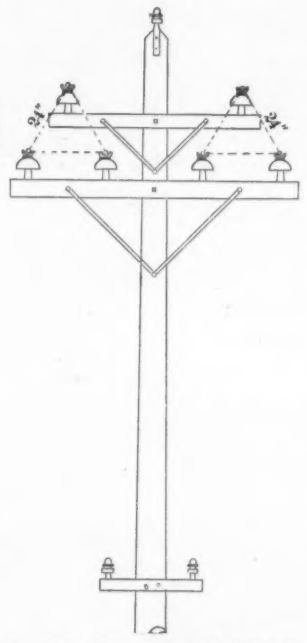

FIG. 8.—POLE TOP FOR 11,500 VOLTS.

On the line to Fort Mill and Charlotte, the river was crossed by means of two spans each 350 ft. in length, a timber crib loaded with stone having been built in the middle of the river, on which were erected a well-braced A-shaped tower carrying beams on which the two circuits were placed. The wires are here spaced 6 ft. apart. To the point where the line to Fort Mill separates from the line to Charlotte, 1½ miles from the power house, the poles are placed 100 ft. apart and are to carry two circuits of No. 0 hard-drawn bare copper wire with a spacing of 4 ft. Thomas No. 6 T porcelain insulators are used. These are 6¾ in. in diameter and 5½ in. high, withstanding a brine test of 70,000 volts. It is intended for the present to operate this line at 11,500 volts, but it is expected eventually to install power house transformers to step the pressure up to 22,000 volts.

From the junction with the Fort Mill line to Charlotte an aluminum cable of 208,000 circular mils is used upon poles spaced 150 ft. apart. Transposition of the wires of these circuits is effected by spiraling every 2½ miles, two complete revolutions being made. It is designed to carry 3,000 hp with a loss not to exceed 10 per cent. over this line. The lightning protecting and telephone equipment is similar to the one on the Rock Hill line. Over the Fort Mill branch on poles spaced 125 ft. apart, the current is conducted on No. 2 copper wire.

At Charlotte it is proposed to erect a sub-station. The step-down transformers there are wound for 20,000 and 11,000 volts primary and 2,200 and 550 volts secondary circuit. An auxiliary steam plant will probably have to be erected at this point, but mills and other large consumers will be served from the high-potential circuit.

To Mr. Emil Knichling, of New York, is due the design of the hydraulic portion of the development, while the engineering features of the whole equipment have been under the direction of W. S. Lee, Jr., of Rock Hill, S. C., as vice-president and chief engineer of the Catawba Power Company. The plant was conceived and financed by Dr. W. Gill Wylie, of New York, and cost over $1,000,000.

The Automobile Tour to St. Louis.

The most ambitious automobile tour on a large scale ever undertaken in this country is that which is to concentrate several lines of travel to the St. Louis Exposition, starting from remote cities. The touring committee of the American Automobile Association has worked the affair up very successfully, and now a large number of automobiles are entered for this interesting run, which, taking place at this season of the year, ought to be favored with fine weather and dry roads. It is not to be expected that electrical automobiles will enter, but several men well known in the electrical field will be in line for active participation. Among them may be mentioned Mr. Charles Glidden, from Boston; Dr. W. J. Morton, Ray D. Lillibridge and F. A. La Roche, from New York; Mr. A. R. Pardington, from Brooklyn, L. I.

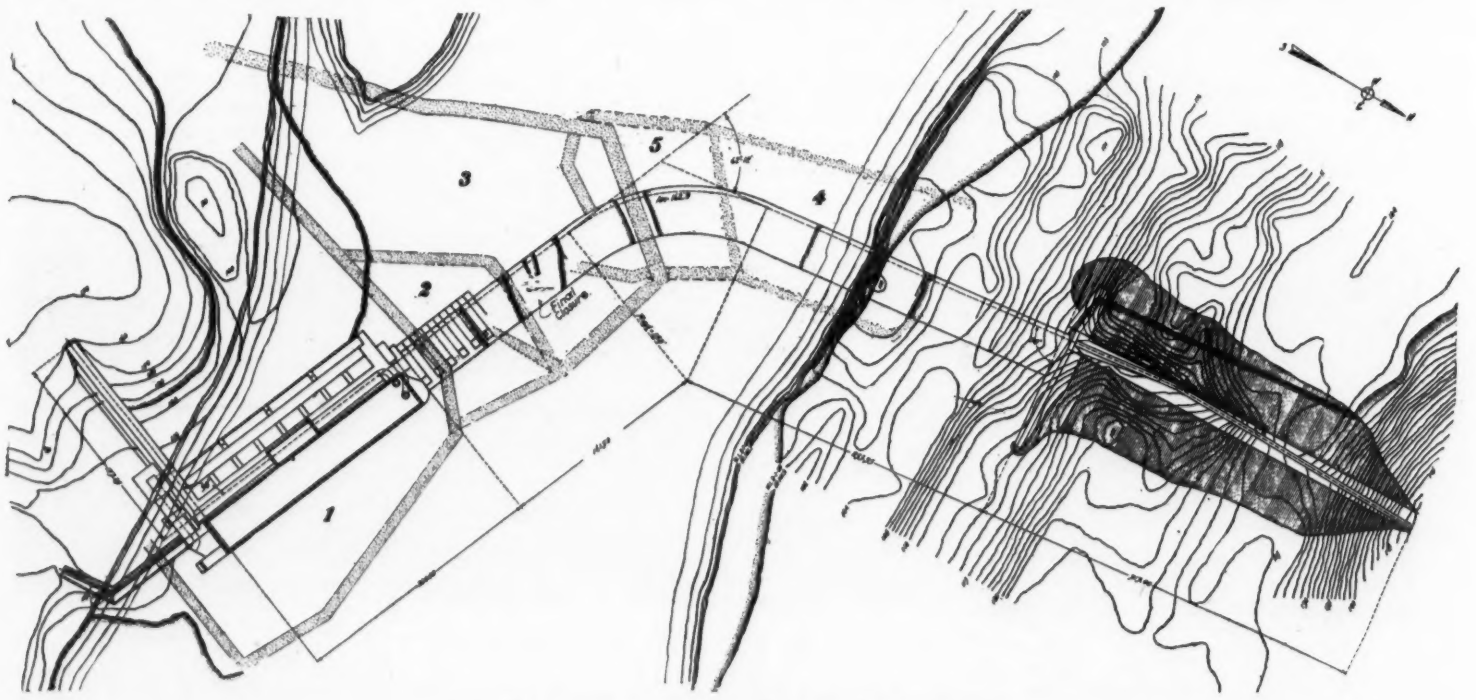

FIG. 9.—TOPOGRAPHICAL PLAN OF PROPERTY.

On the Complex Product of Electromotive Force, Current and Other Vectors.*

BY HENRY T. EDDY.

A COMPLEX expression such as $Z = x + jy$ may stand for a vector, or for a complex number merely, according to the nature of the quantity it is used to represent. In case it stands for a complex number merely, it is still possible to lay off x and y graphically as the rectangular co-ordinates of a point at an absolute distance, $Z = \sqrt{x^2 + y^2}$, from the origin and in a direction such that $cos\ (x\,z) = x/z$, but in making this graphical construction it should be distinctly understood that it is merely a convention used for convenience to thus represent complex numbers by their position in the plane of $x\,y$. And since according to the conventions of arithmetic and ordinary (arithmetical) algebra the product of two numbers is also a number, it follows that the product of two complex numbers may also be represented in the same plane of $x\,y$ (or number plane as we may call it), though for the sake of clearness it would be better to represent the product upon a separate plane of $x\,y$, as is ordinarily done in the theory of analytical functions.

We may also consider at the same time the product obtained by multiplying two complex factors, one of which, $C = a + jb$, is a complex number, and the other, $Z = x + jy$, is a geometrical vector of some kind, which has actual direction and magnitude in space. For in this case also it is evident that when the vector, Z, is multiplied by the number C the product is of the same kind as Z, and its complete representation will lie in the same plane, $x\,y$, in which Z lies, though for distinctness it may be better to draw the result separately. In both these cases the rules and conventions of arithmetical algebra hold, so that the order of the factors in such a product may be arbitrarily changed without affecting the result in any way. But should we attempt to find the product of two vectors such as e.m.f. and current, each of which is represented algebraically by a complex quantity, the process of multiplying one by the other would no longer be simply arithmetical in its nature, but is an operation requiring the adoption of certain additional conventions and interpretations respecting which it may be possible perhaps to adopt arbitrarily either of several differing systems.

Grassman, in his epoch-making work on the doctrine of extension has attempted to show that such an operation must of necessity lead to one particular system of interpretation. The nature of the reasoning by which he has sought to establish the necessity of the laws he has enunciated for vector multiplication is such that the reasoning has not been universally accepted. But, be those laws necessarily valid or not, there is no question that his system of interpretation is not only not incorrect, but is amply justifiable as one whose advantages so greatly outweigh those of any other, especially in the domain of physical and mechanical theory, that its fundamental ideas should be adopted at once whenever vector analysis is applied to any subject such as finding the power of alternating currents.

The true nature of vector multiplication may perhaps be made more clear by first developing and interpreting at length the process of arithmetical multiplication of a complex number by another number or by a vector and then doing the same for the product of two vectors and noting the modifications of the usual rules of algebra required in order to preserve a physical significance for the product.

Let $$C = a + jb \quad \text{and} \quad Z = x + jy \qquad (1)$$
be two complex quantities of which one at least is a mere number, not a vector. As is well known, their absolute values are:
$$c = \sqrt{a^2 + b^2}, \quad \text{and} \quad z = \sqrt{x^2 + y^2}. \qquad (2)$$
These complex quantities may also be conveniently represented trigonometrically:
$$C = c\ (cos\ x + j\ sin\ x), \quad and \quad Z = z\ (cos\ \Theta + j\ sin\ \Theta) \qquad (3)$$
from which the absolute values in (2) also follow.

Now, according to the rules of arithmetical algebra, the product of the complex quantities in (1) and (3) may be written in either of the following equivalent forms;
$$\begin{aligned} C\,Z &= a\,x + j^2\,b\,y + j\ (a\,y + b\,x), \\ &= a\,x - b\,y + j\ (a\,y + b\,x), \\ &= c\,z\ [cos\ a\ cos\ \Theta - sin\ a\ sin\ \Theta + j\ (cos\ a\ sin\ \Theta + sin\ a\ cos\ \Theta)] \\ &= c\,z\ [cos\ (a + \Theta) + j\ sin\ (a + \Theta)]. \end{aligned} \qquad (4)$$
It is to be noticed that in case we desire to represent this product graphically upon the plane $x\,y$, the absolute value will be:
$$\sqrt{(a\,x - b\,y)^2 + (a\,y + b\,x)^2} = \sqrt{(a^2 + b^2)\ (x^2 + y^2)} = c\,z, \qquad (5)$$
which is the arithmetical product of the absolute values of the component factors, but its position angle is $(a + \Theta)$, the algebraic sum of the position angles of its factors.

This last statement, since it makes the position angle of the product depend upon the position of the initial line, shows that the actual position in the plane, $x\,y$, of the product of two given factors would be differently situated with respect to those two factors according to the position which might be assumed for the initial line from which position angles are reckoned. For example, if the line of either of the factors be assumed as the initial line the product will have the same position as the other factor, and by suitably choosing the initial line the product may be made to have any desired direction. This does not correspond to real phenomena in the domain of mechanics, where physical results must be independent of arbitrarily assumed axes; yet in the analytical theory of functions this and other like relations due to the conventions adopted in arithmetical multiplication receive full graphical and geometrical representation in the generalized theory of map-drawing on Riemann's surfaces. To make this still more evident let each of the position angles, a and Θ, receive a common increment, δ, either by rotating both by that amount, or by changing the position of the initial line so that the position angles of the factors become respectively $a + \delta$ and $\Theta + \delta$. Then their sum, $a + \Theta + 2\,\delta$, is the position angle of the product. It thus appears that while the factors have their position angles increased by the common angle, δ, and the angle between them is unchanged, the product is itself rotated through an angle δ with respect to each of the factors, and through an angle $2\,\delta$ with respect to the initial line. Thus the arithmetical product of two complex factors (not both vectors) depends upon the position of the initial line with respect to them and not upon $a - \Theta$, the angle between them, as would be expected in case they were both vectors, i. e., physically directed magnitudes. The effect of this is that in case the position angles of the factors increase uniformly with the time, as in case of uniform rotation, the product rotates twice as fast as the factors, and in any case the rotation of the product is the algebraic sum of the rotations of the factors.

In case the position angle of each of the factors is increased by δ the product (4) becomes:
$$C\,Z = c\,z\ [cos\ (a + \Theta + 2\,\delta) + j\ sin\ (a + \Theta + 2\,\delta)]. \qquad (6)$$
Moreover, if δ be regarded as a variable which increases uniformly with the time, then, as previously stated, (6) shows that the product rotates twice as fast as the factors C and Z, so that while the extremities of C and Z describe the circumferences of concentric circles whose radii are c and z, respectively, with uniform velocities; the extremity of the product $C\,Z$ also describes a circle concentric with these whose radius has the numerical value $c\,z$, but this circumference is described twice as often. With a view to certain important interpretations of the product (6) we write out the following trigonometric expansions of (6) obtained by obvious elementary steps:
$$\begin{aligned} C\,Z &= c\,z\ cos\ (a + \delta)\ [cos\ (\Theta + \delta) + j\ sin\ (\Theta + \delta)] - c\,z\ sin \\ &\qquad (a + \delta)\ [sin\ (\Theta + \delta) - j\ cos\ (\Theta + \delta)] \qquad (7) \\ &= c\,z\ cos\ (a + \delta)\ [cos\ (\Theta + \delta) + j\ sin\ (\Theta + \delta)\ ] - c\,z\ cos \\ &\qquad (a + \delta \pm 90°)\ [cos\ (\Theta + \delta \pm 90°) + j\ sin\ (\Theta + \delta \pm 90°)] \end{aligned}$$
This expression may be taken as the difference of two expressions which are identical except for a difference of phase of 90°, each of which is the product of a harmonically varying factor by a uniformly rotating factor of constant absolute value.

Having thus considered the graphical interpretation and representation of the arithmetical product of two factors of constant magnitude, let us now extend our discussion of arithmetical products to include the case of two factors, one of which varies harmonically in magnitude with the time.

Let δ increase uniformly with the time, then $Z = z\ [cos\ (\Theta + \delta) + j\ sin\ (\Theta + \delta)]$ is a uniformly rotating factor of constant absolute value, z, with initial position angle Θ, and $A = c\ cos\ (a + \delta)$ is a numerical harmonically varying factor whose period of oscillation is the same as that of rotation of Z. The factor A is the projection upon the axis of x of the uniformly rotating constant factor,
$$C = c\ [cos\ (a + \delta) + j\ sin\ (a + \delta)].$$
Now, the product of the constant factor, Z, by the harmonically varying factor, A, evidently varies harmonically. We have:
$$\begin{aligned} A\,Z &= c\,z\ cos\ (a + \delta)\ [cos\ (\Theta + \delta) + j\ sin\ (\Theta + \delta)] \\ &= \tfrac{1}{2}\,c\,z\ [cos\ (a - \Theta) - j\ sin\ (a - \Theta) + cos\ (a + \Theta + 2\,\delta) \\ &\qquad + j\ sin\ (a + \Theta + 2\,\delta)], \end{aligned} \qquad (8)$$
which may be represented graphically by the geometrical sum or

*Revised from a paper read under this title at the Pittsburg meeting of the A. A. A. S., July, 1902, and from a paper entitled *Multiplication of Complex Numbers and Vectors Compared*, read before the Am. Math. Soc., Sept., 1903.

resultant of two vectors, each numerically equal to $\frac{1}{2} c z$, the first one having the invariably fixed position angle, $-(\alpha - \theta)$, and the other having the initial position angle, $(\alpha + \theta)$, and revolving uniformly twice as fast as the factor, Z, just as in the case of the product (6) of the factors C and Z. In other words, as δ varies with the time, the extremity of $A Z$ will describe the circumference of a circle of radius $\frac{1}{2} c z$, whose center is at the fixed extremity of $\frac{1}{2} c z$ $[cos\ (\alpha - \theta) - j\ sin\ (\alpha - \theta)]$. This circumference passes through the origin and is completed twice during each oscillation of A.

Similarly, $B = c\ j\ sin\ (\alpha + \delta) = c\ j\ cos\ (\alpha + \delta - 90°)$ is a numerical harmonic factor, which is the projection of C on the axis of y, and

$$B Z = -\tfrac{1}{2} c z\ [cos\ (\alpha - \theta) - j\ sin\ (\alpha - \theta) - cos\ (\alpha + \theta + 2\delta) - j\ sin\ (\alpha + \theta + 2\delta)], \quad (9)$$

which may be represented as the resultant of two vectors, each of the numerical magnitude $\frac{1}{2} c z$, the one having the invariable position $-(\alpha - \theta) + 180°$ and the other starting from the initial position $(\alpha + \theta)$ and rotating twice as fast as Z, also varies harmonically. It will be noticed that $C Z = (A + B) Z$ has the value (6), and that (7) expresses the sum of two harmonic oscillations differing in phase by 90°, into which the uniform rotation of (6) may be resolved.

Furthermore, it is of interest to notice the average values of the harmonic expressions (8) and (9) during a complete rotation, while δ increases from 0 to 2π. Since the average value of the terms involving δ is evidently zero, the average values of (8) and (9) are, respectively:

$$\pm \tfrac{1}{2} c z\ [cos\ (\alpha - \theta) - j\ sin\ (\alpha - \theta)], \quad (10)$$

and the absolute values of these averages are, respectively, $\pm \frac{1}{2} c z$, the distances from the origin to the centers of the circles about which the uniformly revolving components in (8) and (9) rotate.

The average value of (6) is zero.

Having now discussed the graphical representation and interpretation of the product of two factors when the multiplication is governed by the laws of arithmetical multiplication, we now proceed to consider geometrical multiplication where both of the factors are physical vectors of some kind. They must then in general be represented algebraically by complex expressions, but the interpretation of the meaning which must be given to their product will be controlled by the physical and mechanical properties which we find it necessary or convenient to associate with this operation of multiplication, and the laws of such multiplication will be controlled in the same manner independently of arithmetical results. This will appear as follows: Let E and I be two coplanar physical vectors which, when expressed in complex form, may be written:

$$E = e_1 + j e_2 = e\ (cos\ \alpha + j\ sin\ \alpha),\ if\ e = \sqrt{e_1^2 + e_2^2} \quad (11)$$
$$I = i_1 + j i_2 = i\ (cos\ \beta + j\ sin\ \beta),\ if\ i = \sqrt{i_1^2 + i_2^2}$$

in which the position angles, α and β, designate the respective angles made by these vectors with some assumed initial line in their common plane. The product of these expressions, in case the sequence in the order of the monomial factors is observed, is:

$$E I = e_1 . i_1 + j e_2 . j i_2 + e_1 . j i_2 + j e_2 . i_1. \quad (12)$$

In this polynomial product the monomial factors of each term have been kept separate and their original order preserved, with the view of inquiring whether any changes in this order are of material consequence in determining the significance of the terms of the product or their interpretation. It is, moreover, assumed that the order in which successive terms are added to each other in the summation of this polynomial product is immaterial. Now, when E, representing the first of these vectors, is placed immediately before the second vector, I, in the product $E I$, that signifies that some kind of physical or geometrical operation is to be performed by E upon I, and whatever that operation may be which we are calling multiplication, the product must depend upon the vectors E and I alone, and be wholly independent of any initial line or lines of reference. For a vector, such as E or I, is a thing apart from and independent of any coordinate axes, and whatever their product may be, it evidently depends upon its factors alone. Such a product must, therefore, differ from the arithmetical product of complex factors before obtained in (4), (6) and (7), where the result was found to depend upon the choice which might be made arbitrarily as to the position of the initial line from which position angles were measured. It being now established that the result of this kind of multiplication must have a geometrical and physical significance independent of lines of reference, it will simplify the inquiry as to what such a product actually is if we at first take one of these vectors, E for example, as the initial line from which to measure position angles. In this case the product reduces to:

$$E I = e\ (i_1 + j i_2) = e . i_1 + e . j i_2 = e . i\ cos\ \beta + e . j i\ sin\ \beta, \quad (13)$$

in which i_1 is the projection of I on E, and i_2 is its projection on a line perpendicular to E, while β is the angle between E and I. It then appears that the term:

$$e i_1 = e i\ cos\ \beta \quad (14)$$

is the product of two factors lying in the same direction, and the term is essentially positive or negative in value, according as β is less or greater than 90°. Furthermore, the order of the factors in this term is evidently immaterial, so that $e i_1 = i_1 e$; for of two parallels it is unimportant which of them be taken first. The same cannot be said of the remaining term:

$$e . j i_2 = e . j i\ sin\ \beta, \quad (15)$$

for it is the product of two factors which represent vectors or components of vectors situated at right angles to each other. We may illustrate the difference between (14) and (15) by supposing, for example, that E represents a mechanical force and I a distance; then $e i_1$ is the work performed or received by E in moving a distance i_1 along a line in the direction of E, but $e . j i_2$ is then the moment of the force E at the extremity of the arm, $j i_2$ perpendicular to it. The sign, however, of this moment or torque will depend upon our choice as to which extremity of the arm the force is applied at. It is necessary to adopt a convention as to the order in which those perpendicular factors shall be placed with respect to each other. The order may be indicated by the order in which they are written, though it is unimportant what that convention be, provided it be adhered to consistently. Let us assume, then, that a vector and its projections are positive in sense when traversed or measured from its initial extremity (or butt) toward its final extremity or point.

In constructing a term such as $e . j i_2$, let e be traversed from butt to point first, since it is written first, and then having the butt of $j i_2$ placed at the point of e, let it next be traversed. We are able then to pass a pencil continuously and successively along these factors in a positive sense from the butt of the first one to the point of the second. When they have been so placed we say that they are located in accordance with our convention so as to correctly represent this term.

Next let us compare with the foregoing the expression $j e . i_2$. In accordance with our convention we are first to lay off or describe $j e$ in a direction perpendicular to E; that is, so that a distance traversed in a positive sense along it makes an angle of $+ 90°$ with a distance traversed positively along E; and then at the point of $j e$ place the butt of i_2, which itself lies parallel to E and is positive in the same sense. On making this construction it is evident that the product of the perpendicular factors in this expression, while of the same numerical magnitude as that considered just before, exerts a torque to produce rotation in the opposite sense. This change of sense should be expressed by change of sign; consequently,

$$e . j i_2 = -\ j e . i_2.$$

This result depends in no way upon our assumption that the vectors E and I represent a force and a distance; it would be equally true in case of an e.m.f. and a current, or any other pair of related physical vectors. Since the same change of sense would hold for any pair of perpendicular vectors, we may say in general that the change in the situation of the directional operator, j, from one factor to the other of two perpendicular vectors reverses the sign of the product. We may then write (13) in the form:

$$E I = e i\ cos\ \beta - j e i\ sin\ \beta = e i\ (cos\ \beta - j\ sin\ \beta) \quad (15)$$

Now, in resuming the consideration of the general expression for the product of two vectors given in (12), we have need, in addition to terms already discussed, to interpret the term $j e_2 . j i_2$, which being the product of parallel vectors, is evidently identical in value with $e_2 i_2$. But this may also be regarded as following the same rule respecting change of sign with change of j from one factor to the other, for we may write:

$$j e_2 . j i_2 = -\ j^2 e_2 i_2 = e_2 i_2.$$

We may therefore state the general rule for vector products of factors either perpendicular or parallel, that successive permutations of j between the factors cause successive reversals in the sign of the product.

We are now in a position to consider the general expression for the product of two vectors given previously in (12) and show that it has the same meaning as has been found for our simplified expression for the product (13). By the help of the rule we have just reached as to changes of order we may now write (12) in the several forms:

$$\begin{aligned} E I &= e_1 i_1 - j^2 e_2 i_2 - j\,(e_1 i_2 - e_2 i_1), \\ &= e_1 i_1 + e_2 i_2 - j\,(e_1 i_2 - e_2 i_1), \\ &= e i\,(\cos\alpha\cos\beta + \sin\alpha\sin\beta) + j\,e i\,(\sin\alpha\cos\beta - \cos\alpha\sin\beta) \\ &= e i\,[\cos(\alpha-\beta) + j\sin(\alpha-\beta)], \end{aligned} \qquad (16)$$

in which expression the real and imaginary parts have identically the the same meaning and value as the two corresponding parts of the product (13), which have been already treated at length. It is to be particularly noted that the product (16) is wholly independent of the position of the initial line of the factors; for the angle $(\alpha - \beta)$ is the angle between the given vectors and will be unchanged by any changes in the position of the initial line. In this particular is to be found the essential divergence between geometrical or vector multiplication as expressed by (16) and arithmetical multiplication as given in (6). The complex product (16) may itself be a vector or it may be simply a complex number, depending upon the nature of its vector factors and the number of dimensions defining the space in which the operation has occurred, a subject fully elucidated in Grassman's Doctrine of Extension previously referred to. In any case, however, if we proceed to represent (16) graphically its terms should be constructed on a complex plane, which is understood to be entirely separate and distinct from that employed in expressing its separate factors. This must be true since the number of its dimensions and its intrinsic significance is different from that of each of its component factors. In this product plane the numerical value of the product is $e i$ and its constant position angle $(\alpha - \beta)$. If now the vectors in (16) be simultaneously rotated through an angle δ, this motion will evidently cause no change in the last number of (16), for the difference of the new position angles $(\alpha + \delta)$ and $(\beta + \delta)$ still has the constant value $(\alpha - \beta)$. Comparing this product of two rotating vectors with the product of two rotating complex arithmetical factors, we may say that while the product of two simultaneously rotating arithmetical factors gains on them as much as they gain; the product of two simultaneously rotating vectors lose position angle with respect to them as much as they themselves gain, and so it stands still. And in the general case where the factors rotate at unequal rates, while an arithmetical product gains position as much as both its factors together, a vector product gains only at a rate which is the difference of the rates at which its separate factors are gaining. To illustrate the physical significance of (16), E and I might be taken to represent a force and a velocity respectively, in which case the two terms of the product would be respectively the rate at which work varies (i. e., power) and the rate at which torque varies.

Next, let us proceed to consider the significance of the product of two vector factors, one of which is a vector of constant length, but rotating with a uniform angular velocity, while the other is a vector whose position is constant, but whose length varies harmonically in a period equal to that of the rotation of the other factor. In order to effect this conveniently we shall base the consideration upon the product of two vectors of constant length, both rotating with the same uniform angular velocity. We shall consequently consider this product first:

$$\begin{aligned} &\text{Let } E = e\,[\cos(\alpha+\delta) + j\sin(\alpha+\delta)] \\ &\text{and } I = i\,[\cos(\beta+\delta) + j\sin(\beta+\delta)] \end{aligned} \qquad (17)$$

be two vectors of invariable respective lengths e and i, but both rotating with equal angular velocities, because δ increases uniformly with the time. Then their product, which has been already discussed to some extent, may be arranged as follows in a form to be compared with (7):

$$\begin{aligned} E I &= e\,[\cos(\alpha+\delta) + j\sin(\alpha+\delta)]\; i\cos(\beta+\delta) + e \\ &\qquad [\cos(\alpha+\delta) + j\sin(\alpha+\delta)]\; j\, i\sin(\beta+\delta), \\ &= e i\,[\cos(\alpha+\delta) + j\sin(\alpha+\delta)]\cos(\beta+\delta) - j\,e i \\ &\qquad [\cos(\alpha+\delta) + j\sin(\alpha+\delta)]\quad \sin(\beta+\delta), \\ &= e i\,[\cos(\alpha+\delta) + j\sin(\alpha+\delta)]\cos(\beta+\delta) + e i \\ &\qquad [\cos(\alpha+\delta\pm 90^\circ) + j\sin(\alpha+\delta\pm 90^\circ)]\cos(\beta+\delta\pm 90^\circ). \end{aligned} \qquad (18)$$

From the last line of (18) it appears that the product of two constant vectors uniformly rotating may be written as the sum of two expressions, which are identical except in phase, in which they differ by 90°, and each of these expressions is the product of a constant uniformly rotating vector, e, by a harmonically varying vector of maximum absolute value, i, and oscillating in a period equal to that of the rotation of e. The average value of these two harmonically varying products must consequently be the same. But their sum is given in (16), hence the average value of each harmonic product is one-half the whole:

$$= \tfrac{1}{2}\, e i\,[\cos(\alpha-\beta) + j\sin(\alpha-\beta)]. \qquad (19)$$

As seen by comparison with (10), this result differs from the average value of the arithmetical product in the sign of its phase angle.

Now, the real part of (19) is the average value of the real part of one of the two expressions in (18) $\therefore$ $\tfrac{1}{2}\, e i\cos(\alpha-\beta) =$ one value of $e i\cos(\alpha+\delta)\cos(\beta+\delta)$, (20)
and this is the average value of the product of two parallel harmonically varying factors fixed in position and differing in phase by $(\alpha-\beta)$.

In case E and I designate electromotive force and current, (20) is the time rate of work done, that is the power exerted by an alternating electromotive force and current. Similarly,
$\tfrac{1}{2}\, e i\sin(\alpha-\beta) =$ average value of $e i\sin(\alpha+\delta)\cos(\beta+\delta)$ (21)
which is the average value of the product of two harmonically varying perpendicular vectors, would express the time rate of the torque exerted in an alternating circuit in which the effective volt amperes are $\tfrac{1}{2}\, e i$.

From (18) by elementary reductions it appears that the two equal vector expressions into which the instantaneous value of the vector product was there separated may be written in the following form:

$$\tfrac{1}{2}\, e i\,[\cos(\alpha-\beta) + j\sin(\alpha-\beta)] \pm \tfrac{1}{2}\, e i\,[\cos(\alpha+\beta+2\delta) + j\sin(\alpha+\beta+2\delta)]. \qquad (22)$$

in which the upper sign belongs to the first and the lower sign to the second part of (18). Each of these parts is the same circumference passing through the origin with its center at the point

$$\tfrac{1}{2}\, e i\,[\cos(\alpha-\beta) + j\sin(\alpha-\beta)],$$

but the extremity of one vector is always at a point on this circumference diametrically opposite to the other. This diameter rotates twice as fast as either vector E or I, as is the case also with the arithmetical products (8) and (9).

It is, therefore, perfectly evident that the cause of the double frequency in the harmonic vector products (22) is in no way due to the fact that the factors are vectors, for the harmonic arithmetical products (8) and (9) have the same double frequency; but it is due to the fact that we have to do with the product of *two* factors, and the product of any number of factors other than two would exhibit a frequency corresponding to the number of factors. This is a point on which some misapprehension has seemed to exist.†

In conclusion, then, it may be stated that the more important differences between the arithmetical and vector multiplication of two complex factors arising from the non-commutative character of the latter are these:

1. The position angle of a vector product of two constant factors is the difference instead of the sum of the component position angles, as appears by comparing (16) with (4).

2. The position and magnitude of the vector product of two constant vectors rotating uniformly with a given angular velocity is invariable, instead of rotating with twice the given velocity, as the arithmetical product does, as is evident by comparing (16) or (19) with (6).

3. The product of two vectors, one of which rotates uniformly and the other varies harmonically in equal period may be regarded as the sum of a fixed vector and a vector rotating at twice the given speed. The position angle of the fixed vector is opposite in sign from that of the arithmetical product. Compare (22) with (8).

4. The average value of the harmonic product of two vectors described in 3 differs from that of the corresponding harmonic arithmetical product in the sign of the position angle only. Compare (19) and (10).

5. A complex vector product, being an entity distinct in significance and different in dimensions from its component vectors, may itself be a vector or not, and should be considered to be in a separate plane of its own with an initial line determined by existing physical conditions, which statements do not hold true in case of a complex arithmetical product.

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†Alternating Current Phenomena. C. P. Steinmetz, N. Y. 1900, p. 151.

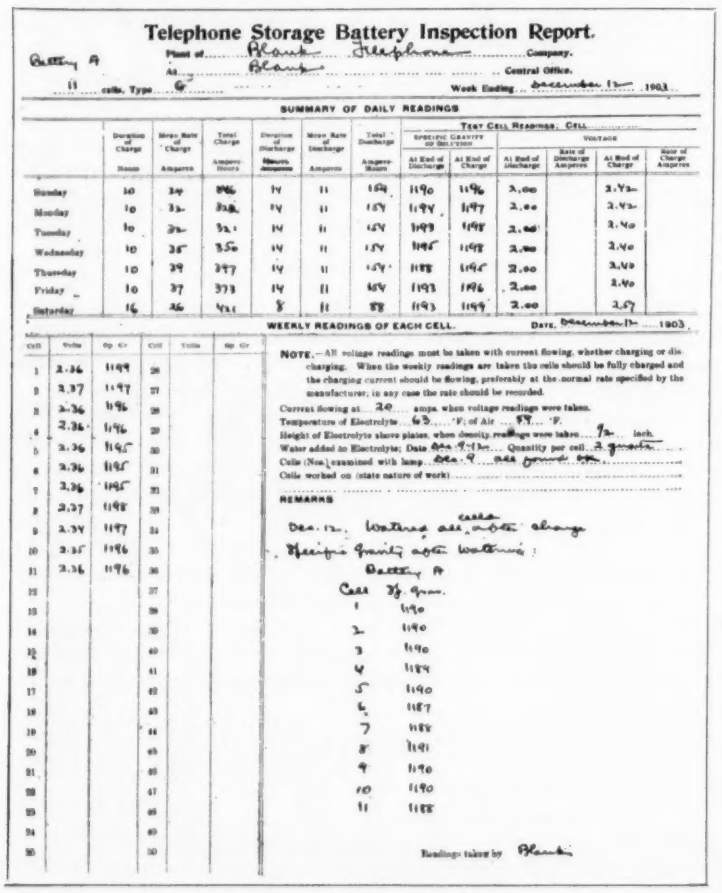
Storage Battery Records in Telephone Practice.

By Howard S. Knowlton.

THE increasing use of storage batteries in central energy telephone exchanges renders it important to maintain accurate records of their behavior. As an expensive piece of apparatus, the storage battery is entitled to the same care and watchfulness that is given to delicate and costly machinery. In fact, its deterioration is likely to be much less evident to the operator of the power room than the depreciation of revolving or oscillating apparatus, and for this reason it is all the more necessary to watch its operation with microscopic eye. The removal of the local open circuit battery from the subscriber's station and its replacement by the storage battery at the central office has greatly simplified the maintenance problem. This has come about partly through the elimination of the magneto-generator ringer and partly through the concentration of the battery power at a single point.

This concentration, however, is accompanied by increased responsibility to maintain absolutely continuous service. Although all properly designed telephone exchanges have at least one reserve source of power at hand, and generally two or three, the breakdown of a battery at a central energy office is a serious matter. Every possible precaution should be taken to avoid such a contingency.

One of the best methods of forestalling battery troubles is to keep a daily record accurately prepared and neatly filled in of the charging and discharging conditions, voltage, specific gravity and appearance of the cells. Once a battery is installed and in operation, there is little excuse for failure to follow its life history from thenceforth. The records should be as systematically kept and filed as banking reports, and it should be as easy for the battery expert to keep the run of the cells' performance as it is for a medical specialist to follow the course of a patient's decline or recovery from the records of the general practitioner or the trained nurse. Unclean or careless reports should never be tolerated, and it is a good plan to have the weekly reports which summarize the daily records regularly sent to one particular member of the engineering department, whose responsibilities are thus made to include the skilled supervision of each battery owned and operated by the company.



Telephone Storage Battery Inspection Report.

Battery A

Plant of Plank Telephone Company.

At Plank Central Office.

11 cells. Type G. Week Ending December 13th 1903.

SUMMARY OF DAILY READINGS

	Duration of Charge Hours	Mean Rate of Charge Amperes	Total Charge Ampere-Hours	Duration of Discharge Hours, Amperes	Mean Rate of Discharge Amperes	Total Discharge Ampere-Hours	Test Cell Readings. Cell ..... Specific Gravity of Solution: At End of Discharge	Specific Gravity of Solution: At End of Charge	Voltage: At End of Discharge	Voltage: Rate of Discharge Amperes	Voltage: At End of Charge	Voltage: Rate of Charge Amperes
Sunday	10	34	340	14	11	154	1190	1196	2.00		2.72	
Monday	10	32	328	14	11	154	1194	1197	2.00		2.72	
Tuesday	10	32	321	14	11	154	1193	1198	2.00		2.70	
Wednesday	10	35	350	14	11	154	1195	1198	2.00		2.70	
Thursday	10	39	397	14	11	154	1188	1196	2.00		2.70	
Friday	10	37	373	14	11	154	1193	1196	2.00		2.70	
Saturday	16	26	421	8	11	88	1193	1199	2.00		2.67	

WEEKLY READINGS OF EACH CELL. Date, December 13th 1903.

Cell	Volts	Sp. Gr.	Cell	Volts	Sp. Gr.
1	2.36	1199	26		
2	2.37	1197	27		
3	2.36	1196	28		
4	2.36	1196	29		
5	2.36	1195	30		
6	2.36	1195	31		
7	2.36	1195	32		
8	2.37	1198	33		
9	2.37	1197	34		
10	2.35	1196	35		
11	2.36	1196	36		
12			37		
13			38		
14			39		
15			40		
16			41		
17			42		
18			43		
19			44		
20			45		
21			46		
22			47		
23			48		
24			49		
25			50		

NOTE.—All voltage readings must be taken with current flowing, whether charging or discharging. When the weekly readings are taken the cells should be fully charged and the charging current should be flowing, preferably at the normal rate specified by the manufacturer; in any case the rate should be recorded.

Current flowing at 20 amps. when voltage readings were taken.

Temperature of Electrolyte 65 °F. of Air 58 °F.

Height of Electrolyte above plates, when density readings were taken ½ inch.

Water added to Electrolyte; Date Dec. 9th 1903. Quantity per cell 2 pounds.

Cells (Nos.) examined with lamp. Dec. 9 944 pounds Elec.

Cells worked on (state nature of work)

REMARKS

Dec. 12. Washing all cells after charge

Specific gravity after washing:

Battery A

Cell	Sp. Grav.
1	1190
2	1190
3	1190
4	1189
5	1190
6	1187
7	1188
8	1191
9	1190
10	1190
11	1188

Readings taken by Plank.

STORAGE BATTERY RECORDS.

An example of a weekly battery record taken from an exchange office having about 2,000 subscribers is shown above. The record sheet is about 8½ in. by 11 in. in actual size, and is of convenient shape for filing, while the spaces between the readings are large enough to incite accuracy on the part of the recording battery man, in putting down his figures. Such a sheet would scarcely satisfy the requirements of a railway battery, which numbers 288 cells for 600-volt trolley service, but the 24-volt telephone battery of 11 cells requires much less clerical space, although it is even more important that it be kept in as near perfect condition as human skill will insure.

Considering "Duration of Charge Hours," in the sample record, it is advisable that the battery should always be charged, as nearly as possible, during the same hours each day. This is because of the daily variations in traffic, which follow a well-defined cycle of maxima and minima in most large exchanges, with "busy hours" or traffic peaks in the middle of each week day forenoon and afternoon, and corresponding "slumps" or depressions during the night. It is thus important that the battery should approach its daily work in a regularly charged condition, if the highest efficiency is to be attained. On Saturdays, when the telephone battery is overcharged, the excess charging is carried on until the voltage and specific gravity reach a maximum; that is, until they indicate the maximum degree of charge. The current entered under "Mean Rate of Charge" should be the actual charging current, which is less than the current given by the generator by the amount taken by the exchange, supplied ordinarily by the battery. During charge the exchange runs by the generator current alone, and care must be taken not to put down this current as a total going into the battery. In some exchanges the switchboard is so wired that the current given by the generator and that received by the battery may be read separately, while in other exchanges the average station load during the time of charge must be judged, and the difference between this and the total generator output may be put down as the charging current. By station load, of course, is meant the total current taken by the exchange, exclusive of the battery charging current.

The total charge in ampere-hours is the product of the duration of charge in hours into the mean rate of charge.

If the battery is charged every day the "Duration of Discharge" will be 24 hours minus the time of charging. When the battery is being charged it is not discharging; the current required by the exchange is taken entirely from the motor-generator or source of power which also charges the battery. Here is a radical difference between telephone and railway battery practice. In electric railway work the storage battery is usually discharged and charged without any physical separation of the two functions, but the telephone battery receives its charge throughout a sustained period of time, and is then discharged throughout a corresponding separate period.

The "Mean Rate of Discharge" is always taken with reference to the time of battery discharge only. If the battery is charged during the time of heavy exchange traffic then the mean exchange load for 24 hours will be greater than the mean rate of battery discharge, which supplies the exchange load during only the time that the battery is not being charged. In order to determine the mean rate of discharge, readings should be taken every five minutes from the switchboard instruments. A set of such readings taken once a month is sufficient to determine the mean rate.

The total discharge in ampere-hours is the product of the duration of discharge into the mean rate of discharge. This will generally be less than the total charge.

Voltage readings at the end of discharge should always be taken before the charging current is thrown on, while the voltage readings at the end of the charging period should be taken just before the charging current is thrown off. In taking weekly voltage readings of individual cells, the potential should be recorded for each cell just before shutting off the charging current on the day of overcharge. Weekly specific gravity readings of each cell should be taken at the end of the regular charge, on the day preceding overcharge. It is desirable to add water to make up for evaporation losses, on the day of overcharge, during the first hour of charging.

Two sets of test cell readings should be taken and the records kept on separate sheets. One of the test cells is to be kept from week to week, and the other is to be rotated. Thus, if we have "cell No. 1" for the first week, we would have "cell No. 2" for the second week, and so on. For the other, or "one-test cell" reports, it is advisable to keep each weekly report on the same cell throughout the month. That is, all these reports should be on "cell No. 11,"

or whichever cell is chosen. The solution in the test cell should be kept at exactly the same level from day to day. For this purpose a gauge should be used to fix the liquid level. This level ought to be from one inch to one-half inch above the tops of the battery plates.

The temperature of the solution plays an important part in determining the specific gravity. A rise of 3° F. will lower this about one point, and a drop of 3° in temperature will raise the gravity about one point. It is advisable to record daily temperature readings taken on the test cell for insertion in the weekly report.

Although the theory of storage battery operation in telephone work is not different in any essential point from that fitted to railway or elevator practice, there is no doubt that the telephone battery has much less to bear in the way of racking service, tremendous instantaneous fluctuations of current demand and long drains of energy at abnormal discharge rates. The absence of these drawbacks should insure long life and low maintenance expenses. It is hardly necessary to say that every expense incurred by the battery should be carefully recorded. Exact data as to battery depreciation is not common outside of manufacturing circles. A recording ammeter is also to be recommended as a valuable adjunct to the telephone battery plant, and if a careful analysis is regularly made of its records, it will add much to the value of the reports, which, as time goes on, will constitute a continuous series of observations possessing high commercial and technical value.

A Simple Method for Calibrating Integrating Meters.

BY DOUGLAS P. MORRISON.

Tests with "standard meters," as heretofore performed, have involved difficulties, due to the complication of the parts of the meters and to the inability of operation by a single observer, the tests ordinarily requiring two persons for taking observations. The writer has sought a method by which one observer could obtain results comparable with those of the "standard meter" method and yet which did not introduce undue complications into the mechanism. Below is given a method which it is believed fulfills this requirement, and of which, so far as known to the writer, no published description has yet appeared.

The method is applicable to any type of meter, of any size or capacity, but in the writer's present experience has been used only with two-wire meters of the induction type. In its use neither the windings nor other electrical features of commercial meters need be altered, the only change made being in the recording mechanism, the gears being adjusted to a ratio of 10 to 1 between the disc shaft and the first indicating hand. There are provided two hands which record and repeat 100 revolutions of the disc. The disc being graduated to 100 parts, from the combination of disc and dial, revolutions and fractions thereof from 1/100 to 100 can be observed. In the shunt circuit of the "standard meter" is introduced an ordinary ball spring switch.

The method of use is as follows: The "standard" and the "unknown" are so placed in the circuit that they measure the same load. The switch in the shunt circuit of the "standard" is then opened, and the reading of its disc and dial noted. When the disc of the "unknown" comes to the starting point, the shunt switch is close, starting the standard, to which no further attention is paid by the observer. The requisite number of revolutions of the "unknown" is noted, and as it comes to the finish, the switch of the "standard" is opened and its disc stopped. Disc and dial are again read, the difference between initial and final observations being the "standard revolutions," which, compared with those observed on the "unknown," give the error of the latter, without reference to the actual load on the two meters.

Repeated observations under test have given duplication of results to within 1/10 of 1 per cent. on full load and ½ of 1 per cent. on 1/30 load.

In practice, the "standard" is compared with a reference standard placed in the position of the unknown, the two operations of calibration and test being identical and, therefore, eliminating any error due to sluggishness in the starting and stopping of the working standard. The reference standard is calibrated in the ordinary way by comparison with indicating instruments.

The method has been experimented with for some time on a large system and has given such good results that a number of instruments have been built and are in constant use.

Another Substitute for Gutta-Percha.

Casual note has been made from time to time of substitutes for gutta-percha, and attention is now being directed to the latest, known as "gutta-gentzsch." Mr. James Swinburne, late president of the Institute of Electrical Engineers, was requested to test half a mile of "gutta-gentzsch" core, and a test of a similar length was begun at the works of Felten & Guilleaume. Subsequently this core was shipped over to England and immersed in a tank at Mr. Swinburne's office for further test. The results of the tests, which extended over a year, were most satisfactory. The material showed a gradual increase in the inductive capacity for about five or six months after manufacture, at the end of which time it became and remained constant. The capacity was at first very much lower than that of similar gutta-percha cable, but eventually rose to, and remained constant at, a value which, as Mr. Swinburne points out in his reports, compares favorably with that of real gutta-percha core of the same dimensions. Samples were also submitted to a well-known rubber expert at Manchester, who investigated the material from a chemical standpoint. In his report he comments very strongly upon the remarkable properties and characteristics of the material, and concludes by stating that "for the applications in which at the present time the bulk of the natural gutta-percha is consumed, the 'gutta-gentzsch,' both by reason of its chemical composition and its physical structure, appears to be eminently suitable." In order to test its behavior under oxidizing agents, samples rolled into sheets 1 mm. thick, each weighed, were for eight days and nights suspended together with similar samples of fine natural gutta-percha in an atmosphere of pure oxygen at a temperature of 30° C. At the end of the time the suppleness of the new "gutta-gentzsch" was practically unimpaired, whereas the real gutta-percha was completely oxidized, and fell to pieces on handling. It is also pointed out by the same expert that "gutta-gentzsch" ought to be an admirable material for the manufacture of belting.

A coil was also submitted to the British postal telegraph authorities and was tested by them for several months, and, as a result, the makers received a trial order of five miles, which was recently delivered, and is now in use. Trial orders were also received from several railway companies in the autumn of last year and repeat orders on a commercial scale have since come to hand, one of the leading railway companies accepting a tender for the supply of "gutta-gentzsch" wire for the coming year. These results fully confirm others noted by the Imperial Post-Office at Berlin.

Among the properties which favor its adoption, in addition to its insulating resistance, is its remarkable toughness. Mr. James Swinburne reports that it does not suffer from bending, and that he was able to break a seven-strand copper core by repeated bending and twisting, without breaking the insulation outside of it. The softening point under heat is considerably higher than that of gutta-percha, viz.: 140° as against about 100°. The specific gravity is about the same as that of water. It cools more rapidly than real gutta-percha, and does not lose its valuable properties when exposed to light and air. The tensile strength is between 600 and 700 pounds per square inch, compared with 350 pounds of the ordinary article.

"Roll-Call" Electric Railway in Washington.

A novel electric railway service is to be established in Washington. The train will make frequent and rapid trips through an underground passage from the Capitol to the two new office buildings to be constructed for the use of the Senators and members of the House respectively.

On the main basement floor of the building will be the terminal station of an up-to-date little electric railway. The passenger cars will be open and will resemble the cars of roller coasters and scenic railways, although more luxuriously upholstered. The little train will go from its station through a brilliantly-lighted subway, under the southeast lawns of the Capitol grounds, and within a very few seconds will halt in the sub-basement of the House wing. Here the members will disembark to find themselves within easy access of the private elevator leading to the floor of the House.

As a counterpart to the House office building, Congress at the session just closed made provision for the construction of an office building for the Senate. The House building is to be located opposite

the southeast corner of the Capitol grounds, while the Senate building will occupy the corresponding square to the northeast. When it is completed the subway and electric trasportation facilities provided for the House will be duplicated.

In addition to the two tunnels leading respectively from the House building and Senate wings of the Capitol, the tunnel will be carried across to the east front so that through trips may be made from the Senate building to the House building.

Amply ventilated, lighted and heated, the interior of the tunnel will be light-colored glazed brick, and all semblance of dampness will be done away with by the most modern methods of water-proofing. There will be passenger and freight trains in operation. The train has been dubbed the "Roll-Call Limited."

Municipal Operation at Richmond, Ind.

A brief analysis is made of the municipal lighting results at Richmond, Ind., by a correspondent of the *American Gas Light Journal*. He says: "The second annual report of the municipal electric light commission has been made public. On the face of the report the plant earned $6,901.76, although the report says it does not include any allowance for interest on bonds or depreciation. The report of the commission stands for itself. There is nothing concealed in it. On the face of it the plant did not make any money, for while the items included in the report show an excess of receipts over expenses of 6,901.76, one of these receipts was a loan of $7,500 from the city, so that the plant's income was not enough to pay for its operating expenses. The loan should not be charged up as an asset; it should be charged up as a liability. It is plain bookkeeping to the average man that in figuring up what he actually earns he does not take into account what he borrows, for that is a debt and must be paid back. But when one goes back of the report and analyzes the situation with the municipal light plant the real truth is startling. As the report says, it makes no allowance for interest on bonds. This is 4 per cent. on $144,000, which amounts to $5,760, and was paid out of the general fund of the city. It makes no allowance for depreciation which, according to all authorities, is 10 per cent., a year on electrical plants. The value of the plant now, according to the commission, is $186,480.97. Of course, this includes the building and other property not to be included in the 10 per cent. depreciation. A deduction of $36,000 for this would be liberal, leaving $150,000 on which to charge 10 per cent. a year for depreciation, making a yearly expense of $15,000. In the usual municipal light plant's report this depreciation appears under the head of 'equipment,' or 'new construction,' but it is new machinery put in to keep up the efficiency of the plant and is known as depreciation. The report shows no allowance for the salaries of the commission and its secretary, which amount to $850 a year.

"The commission has borrowed, all told, since its existence, $25,400 from the city. While it pays no interest on this, the city in turn has to borrow money to take its place and pays 5 per cent. interest, so in the end it comes out of the taxpayer's pocket and should be charged against the plant. The interest would amount to $1,270. In addition to these loans and paying interest for the plant the city also paid the plant something like $8,000 for light. By including these items one can begin to get at some fair conclusion as to what the light plant cost us, the taxpayers, because money paid out by the city for maintenance of the plant must be counted, even if it does not appear in the commissioners' report."

Jacksonville, Fla., Municipal Lighting Plant.

The rapid progress made in the rebuilding of the city of Jacksonville made necessary the consideration of extensions to the city electric plant to meet increasing demands for electric light and power. As the available space was limited and the cost of reciprocating engine foundations excessive, owing to the character of the soil, the steam turbine was given careful consideration. It was finally decided to place two 300-hp De Laval steam turbines, direct-connected to two 200-kw Bullock three-phase, 2,300-volt twin alternators designed for a frequency of 60 cycles, with two 350-hp Babcock & Wilcox boilers, Alberger condenser and other necessary accessories, and later it was also determined to place an additional 300-hp De Laval turbine, direct-connected to a 200-kw,

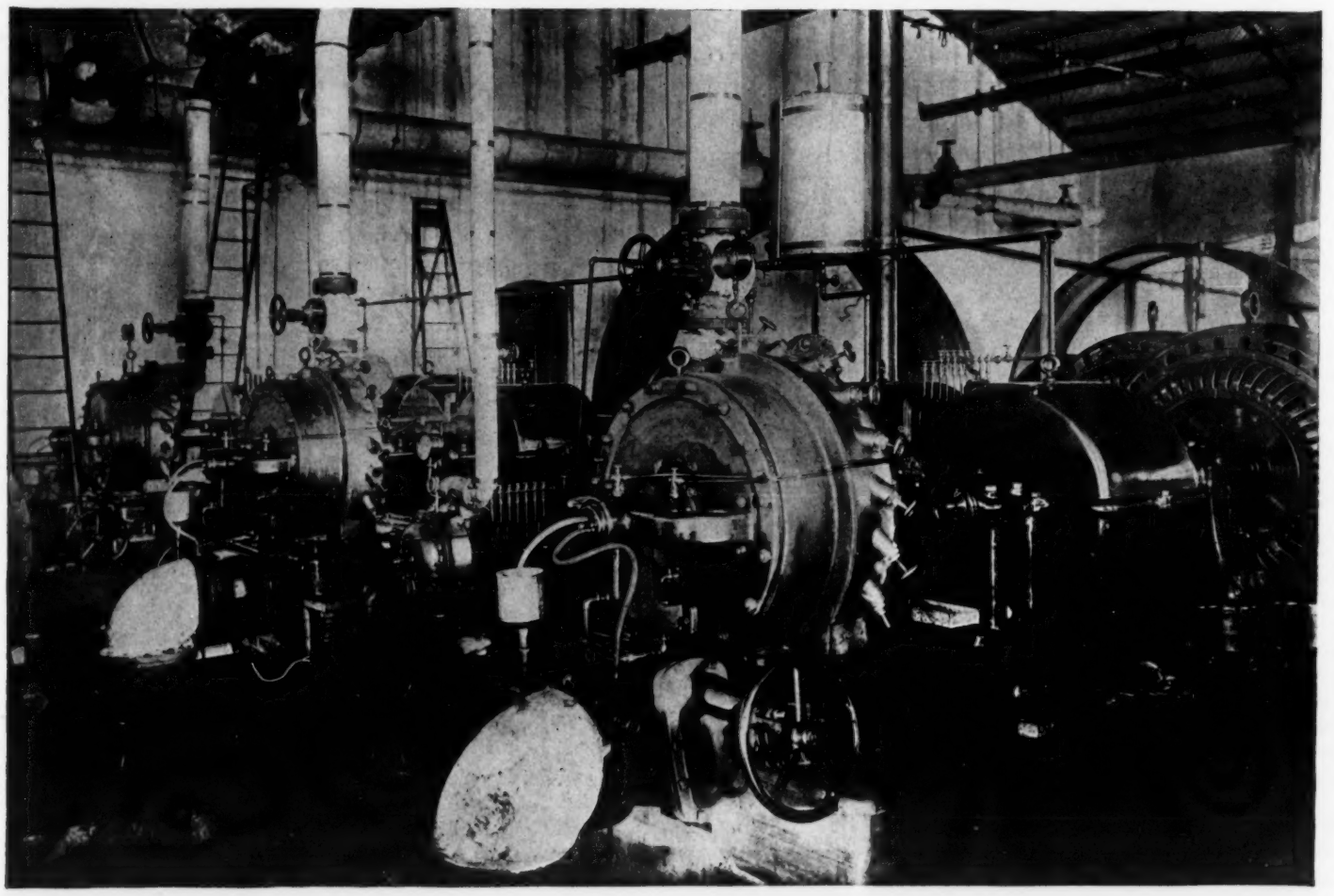


FIG. 1.—VIEW OF INTERIOR OF JACKSONVILLE, FLA., MUNICIPAL PLANT.

500-volt, direct-current generator. The entire contract was assumed and executed by the D'Olier Engineering Company, Philadelphia.

The plant is located near the center of the city, the lines extending about one mile north, one and one-half miles to the east, two miles to the southwest and one-half mile to the west. Alternating current is furnished for lighting, and direct current is furnished over an area of about two square miles for elevator motors and other power service. The general layout of the additional plant installed is shown herewith in Fig. 1. The two Babcock & Wilcox boilers are operated under natural draught, a steel stack 100 ft. high and 60 in. in diameter being used. The boilers are connected to the main steam header, which also connects to the old boiler plant. A working pressure of 200 pounds is maintained and each boiler is equipped with a Babcock & Wilcox superheater, which produces steam superheated to about 100° F. when boilers are operated at their rating. The turbines are operated under these steam conditions and, as will be noted, the high pressure and superheat combined are especially applicable for steam turbine service.

Steam turbines are used exclusively as prime-movers excepting for vacuum pump. The Alberger condenser used is guaranteed capable of condensing 15,000 pounds of steam per hour and to maintain a vacuum of 28 in. with 30-in. barometer; and under these conditions the plant is operated on a most efficient basis.

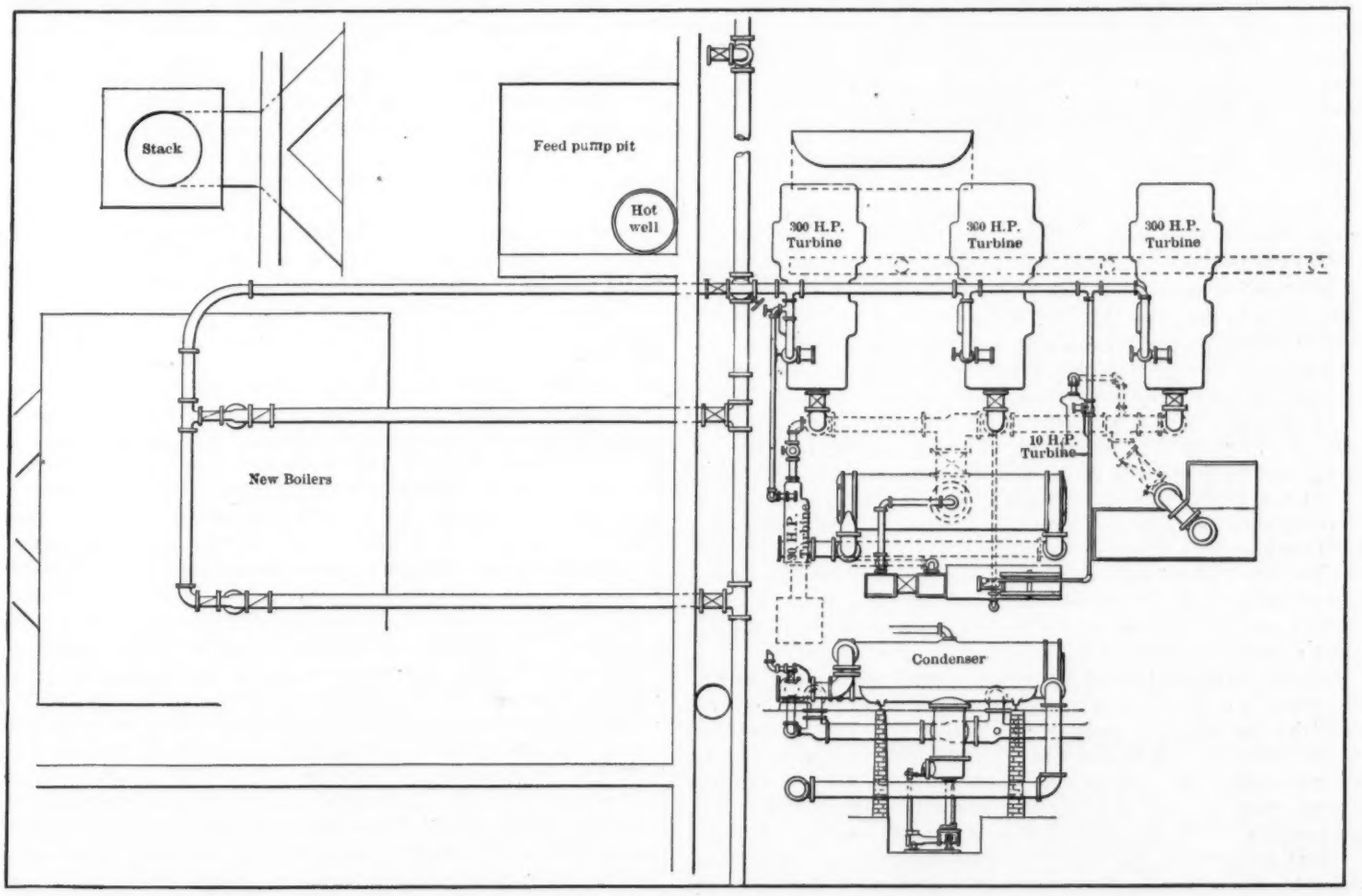


FIG. 2.—PLAN OF BOILER AND ENGINE ROOM, JACKSONVILLE CITY ELECTRIC LIGHT STATION.

The alternating-current switchboard is constructed of Tennessee marble, consisting of three panels supported on angle iron frame. Each generator panel is provided with three ammeters, voltmeter, rheostat, combined oil switch and circuit-breaker and necessary synchronizing device.

The plant as now completed consists of the following apparatus: Four Babcock & Wilcox boilers of 350 hp each and one Caldwell boiler of 350 hp; one Filer-Stowell Corliss cross-compound engine of 750 hp, and two Hamilton Corliss tandem-compound of 350 hp each; four General Electric monocyclic generators, two of 150 and 200 kw respectively, and two 250 kw each; three No. 11 Brush arc dynamos with a capacity each of 125 lights of 2,000 cp. One direct-current, 150-kw, 500-volt generator. Two 300-hp, 200-kw De Laval turbine alternating-current generators and one 300-hp, 200-kw De Laval turbine direct-current generator, with condensers and auxiliaries.

The plant is owned by the city of Jacksonville and is under the supervision of the Board of Trustees for the water works and improvement bonds.

Recent Electrochemical Developments.

FURNACE PROCESS.

A patent granted to C. Diesler is interesting, if considered in connection with the fact that a chemical reaction depends not only on the chemical nature of the reagents, but also on the physical conditions. This fact is sometimes overlooked. According to the principles of thermodynamics any reaction between given chemicals depends on temperature and pressure. The importance of maintaining the correct temperature has long been recognized by electrochemists. The influence of pressure has repeatedly been proven in scientific investigations (especially with respect to electrolytic operations), but has not often been used commercially.

Mr. Diesler's scheme is to let the electric furnace reaction go on under very high pressure and for this reason he uses a tightly-closed vessel. He claims that carbonates and oxides of metals are reduced at a lower temperature in a closed vessel than in an open one; further, the heat of the gases evolved is completely utilized if they are not allowed to escape from the furnace. His patent claims refer to the treatment in retorts from which the air is exhausted, the reaction being brought about by an electric current and by the pressure of the gases in the retort "in excess of 5 atmospheres."

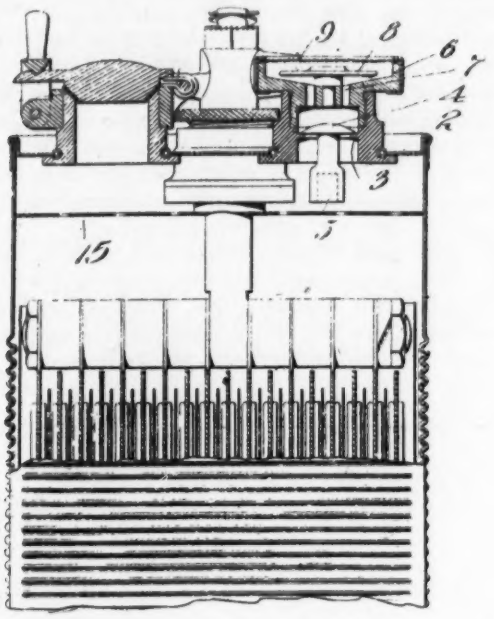
BATTERY INVENTION.

A patent granted on July 5 to T. A. Edison refers to a method of separating mechanically-entrained globules from gases. At the end of the charge of a battery gases are evolved. This is a disadvantage, but a greater disadvantage is that these escaping gases are charged with a fine spray of electrolyte. This has often proved very obnoxious in storage battery traction.

Mr. Edison in developing his nickel-iron-alkaline battery has taken the greatest care to make it as perfect as possible, not only chemically but also mechanically, and the method by which he separates the electrolyte carried away with the gases from the latter before they escape from the battery is very ingenious. The idea is to direct the gases at a high velocity against a film of solution with sufficient force to overcome its surface tension; the entrained liquid globules are then caused to coalesce with the film, so that the gases escape in a dry state free from any objectionable moisture.

The adjoining diagram shows an Edison cell. The cell has, be-

sides the binding posts, two mountings at the top, one called the "filler" for filling in the electrolyte and from time to time distilled water, and the other called the "separator" for separating the spray from the gases when the battery is charged. The filler is shown at



EDISON CELL.

the left hand of the adjoining diagram and the separator at the right hand. It is to the latter that Mr. Edison's patent refers.

Secured in the top of the can with a tight joint is a neck, 2, having a flat seat, 3. Resting upon this seat is a mushroom, puppet or check valve, 4, having a weighted stem, 5. Screwed into the neck, 2, is a casing, 6, formed with bolts, 7, and above these vents is a small dash-plate, 8. Secured over the mouth of the casing, 6, is a disc of wire gauze, 9. The check valve, 4, is normally closed by its weight, so that any gases which may be generated within the receptacle will accumulate in its upper part above the electrolyte. As soon as the gas pressure is sufficient to elevate the check valve, 4, the gases will be permitted to rush at a high velocity through the opening formed between the check valve and the seat, 3, and will forcibly impinge against the bore of the neck, 2, and casing, 6, to deposit liquid thereon and allow of the accumulation of a liquid film.

This film coats the bore of the casing, 6, all around the valve and also deposits on the seat, 3. As soon as the pressure has been relieved by the escape of gases, the weight of the valve again closes it, and the valve will be stuck to a certain extent upon its seat by the interposed film, just as two plates of glass will adhere quite strongly together if a film of liquid is interposed between them. The gas pressure within the cell will, therefore, again rise until it finally becomes great enough to unseat the valve, which is suddenly forced upward. Consequently, the gas again escapes at a high velocity through the space between the valve and the seat, 3, and impinges against the liquid film with sufficient force to overcome its surface tension, causing the entrained globules to coalesce with the film and to be effectively separated from the gases, which escape through the vents, 7, in a dry and non-noxious condition. The accretion which the film thus receives causes a slight accumulation of liquid around the valve and the seat when the valve again seats itself, and when the valve again opens to repeat the separating operation, the surplus liquid not retained by capillarity will flow back into the cell over the valve seat.

The dash-plate, 8, is provided in order to cause the gases, which are of a highly explosive nature, to be diluted and deflected so as to pass through the gauze, 9, in a rarefied and non-combustible condition. The perforated diaphragm, 15, above the battery plates is made of hard rubber. Overcharging of the cell causes the solution to froth; it rises until the diaphragm, 15, is reached and the latter is coated with a film, closing all its perforations. When gas escapes through this film, the electrolyte contained in the gas is separated from the latter in the same way as described above.

A patent granted on July 5 to W. O. Duntley refers to a construction of battery cells which makes it easy to clean and wash them. For this reason he provides the cells with a bottom opening closed by a readily-removable cover. This cell was illustrated and described in our issue of July 16.

CURRENT NEWS AND NOTES.

RAYS FOR BLOOD DISEASES.—A cable dispatch from Turin of July 11 says: "Dr. Bozzoli, director of clinical medicine at the Turin University, has informed the Academy of Medicine that experiments he has made have shown that the X-rays have remarkable efficacy in some serious diseases of the blood. He says that he has cured by this means a supposedly incurable case of leuchæmia."

WIRELESS AT PANAMA.—Mr. Lee, chargé of the American Legation at Panama, has informed the State Department that the Panaman Government has granted to a representative of an American company a concession to establish the wireless system of telegraphy between Bocas del Toro and Colon, and between Colon and Panama. Authorization also is given to connect with wireless systems of other countries of Central and South America. It is understood that this is the De Forest Company.

MUNICIPAL NEWSPAPER OWNERSHIP.—Webster City, Iowa, has established a municipal daily newspaper, to be known as the *Daily Graphic Herald.* It will be issued from the present office of the *Weekly Graphic Herald,* the only Democratic paper in Hamilton County. Webster City began her career as a municipal ownership city many years ago. She first acquired possession of her water works. Next came the electric light and power plant. Then came the city heating plant. Presently all her citizens will be employing each other on salaries out of taxing each other.

WIRELESS TELEGRAPHY ON THE ST. LAWRENCE.—A short time ago it was announced that the Dominion Government intended to install at once several Marconi stations on the St. Lawrence route to the sea. Four are to be installed this season, the points selected being Fame Point, Heath Point, Point Amour and Belle Isle. The station at Fame Point is now ready for business, and the others will be completed by August next. From a point 60 miles above to 60 miles below the station at Fame Point, communication was carried on with the Allan liner *Parisian* a few days ago. It is the intention of the Allan Steamship Company to install Marconi instruments on all its passenger steamships.

A PRIEST'S WIRELESS TELEGRAPH SYSTEM.—A dispatch from Wilkesbarre, Pa., states that Father Joseph Murgas, of that city, the priest who is perfecting a wireless telegraph system, the invention of which he had patented on May 10, has arranged to locate a station at Scranton, twenty miles from Wilkesbarre. He will there carry on a series of experiments to perfect his apparatus. According to the dispatch he employs musical tones to represent the dots and dashes of the Morse code. In the local experiments he has conducted he has used only two tones, one to represent the dot and the other the dash. He hopes now to perfect an apparatus by which each letter of the alphabet may be represented by a tone and in this way gain speed.

GOVERNMENT TELEGRAPHS.—The following is a little "platform committee" episode, reported from the Democratic convention at St. Louis: "Mr. Pettigrew offered an amendment providing for the Government ownership of railroads and telegraphs. 'Oh, that's silly, remarked Mr. Hill. 'I don't mean to be offensive,' he added. 'Oh, I'l not take offense at anything the gentleman says,' retorted Pettigrew, 'especially if it were a matter of opinion.' Pettigrew's amendment was voted down and he remarked: 'The gentleman from New York called that amendment "silly," but he put a plank in the New York platform two years ago, not only for the Government ownership of the coal-carrying railroads, but of the coal mines as well. And the ticket got a larger majority in New York City than was ever before given a Democratic candidate.'"

CUPID ON PARTY TELEPHONE LINES.—A curious mixture of telephony and a lovers' quarrel has just been brought to public attention at Marion, Ohio, where a rejected lover has been placed under bonds to keep the peace. Orrin McClelland, according to a

dispatch from Marion, for five years paid attentions to Miss Florence Bish, of Longville. She discarded him finally for Sidney Northrup. The old and the new lovers were on the same party line, and when Florence made love to Sidney over the wire Orrin, the old lover, caused trouble by breaking in on the tender conversations and repeating among the townsfolk what he had heard. This led to violence among the parties concerned, and some of the encounters were characterized by the use of clubs, pitchforks, etc. The courts had to be appealed to, with the result above stated.

TRANSPORTATION IN NEW YORK CITY.—In response to repeated requests made by the Merchants' Association of New York, the State Railroad Commission, in a letter addressed to Mr. William F. King, chairman Committee on Franchises and Transportation, has appointed a public hearing in New York City for Friday, July 29, at 10.30 a.m., in the Whitehall Building, Battery Place, to consider the suggestions to be made by the Association's Committee on Engineering and Sanitation with a view to improved transportation facilities in this city. This latter committee claims to have made an exhaustive examination of these conditions, and is of the firm opinion that very great improvements can be made by the street railway companies. It proposes to submit to the State Railroad Commission the apparent results of its examination, to justify the reasons for its belief.

RULES FOR CAR WIRING.—The Underwriters' Laboratories of the National Board of Fire Underwriters have received from Mr. C. M. Goddard, secretary of the Underwriters' National Electric Association, and are issuing the supplement to the 1903 edition of the National Electrical Code, containing rules on car wiring formulated by a conference committee from the Underwriters' National Electric Association and the American Street Railway Association, and adopted by the National Board of Fire Underwriters for government of the electrical wiring and equipment of street railway cars. Mr. Goddard states that rules on such a special subject do not need indiscriminate distribution among the ordinary electrical contractors, and that the first edition has been limited to 10,000 copies. Orders for such extra copies as may be needed should be sent to the National Board of Fire Underwriters, 32 Nassau Street, New York City.

ALASKA CABLE LAYING RESUMED.—Gen. Greely, chief signal officer of the army, is informed that the laying of a submarine cable between Seattle and Sitka, which was interrupted last fall by storms, has been resumed. As soon as this work is finished the cable ship Burnside will lay a cable between Sitka and Valdez, which are 750 miles apart, and complete an all-American telegraphic system for Alaska. The system will be more than four thousand miles long and more than half of it will be submarine cable. It will be maintained entirely by the army, but will handle commercial business, and will greatly reduce present rates by way of Canadian lines. There is no intention on the part of the Signal Corps to lay a cable between Valdez and Nome. When the Sitka-Valdez cable is laid there will be an all-American connection between the States and the interior of Alaska. At present the connection contains a Canadian link.

POLYPHASE TRANSFORMATION.—If two vectors, equal in value but displaced 120 degrees in phase, be combined directly, the resultant will have a value equal to that of each of the initial vectors, and will occupy a relative phase position 60 degrees ahead of one or 60 degrees behind the other. If, however, one vector be reversed and the two then be combined, the resultant will have a value $\sqrt{3}$ times that of each of its components and will be displaced 30 degrees from each. It is evident, therefore, that by using proper ratio of turns, the coils of a three-phase transformer or of the transformers of a three-phase circuit may be so interconnected as to give e.m.f's in quadrature and of equal value. This fact furnishes the foundation for a patent issued July 5, 1904, to C. P. Steinmetz upon a system of electrical distribution, for which the application was filed January 23, 1895. The claims seem to cover all methods of transformation from two to three phases or three to two phases by combination of polyphase fluxes, and to be restricted thereto.

AMERICAN COMPETITION IN AFRICA.—In discussing the rapid electrical development of the Dark Continent, and citing recent work, *South Africa* says: "In one important respect British manufacturers of electrical and mining plants are handicapped in competition with America. This is due to the fact that the American engineer is very much in evidence in South Africa. In many mines and groups of mines plant and equipment are placed under American control, with obvious and disastrous results to the British manufacturer. The sympathies of the American engineer are with American manufacturers; his taste for American machinery is as pronounced as his success in installing it upon the mines under his charge. Assistant engineers and staff are quickly Americanized, and so far as the machinery and equipment are concerned, particularly where it is electrical, this section of the market is dead to the British manufacturer. In the early days of mining on the Rand excuse was not wanting for such a procedure, for England could supply neither the men nor the plant. To-day matters have entirely changed, but the result remains the same; and while British engineers and British mining and electrical plants are second to none, the American engineer is often given the preference, and under his guidance American machinery installed. In this matter hundreds of thousands sterling of plant have been diverted from English into American channels."

DIVISION OF LOAD BETWEEN SYNCHRONOUS MOTOR-GENERATOR SETS.—Owing to the fact that the division of load between two synchronous generators running in parallel depends upon the relative mechanical phase position of the armatures of each, when two generators are driven by two synchronous motors receiving energy from the same supply mains, the angular phase displacement of the one generator from the other tends to remain at the value assumed when the two motor-generator sets were initially parallel, and manipulation of the field rheostats of the motors or generators has no effect on the division of load between the two. In order to obtain means for controlling the division of load between such sets, Mr. J. E. Woodbridge, according to a patent issued to him July 5, 1904, employs adjustable inductances in the several circuits to the motors. When it is desired to place a motor-generator set in parallel with another running under load, the motor element of the set is connected to the supply circuit through proper inductance, the generator element remaining disconnected from the consumption circuit. The idle generator will now be running at exactly the same speed as the loaded one, and may be given the same mechanical phase position by adjustment of the inductances in its supply circuits. When this condition is found to exist, the two generator elements are thrown in parallel; and the load is divided between them by relative shift of the mechanical phase of the incoming generator by further change of the inductances in the circuits to its driving motor.

LETTERS TO THE EDITORS.

Alternating-Current Wave Form Analysis.

To the Editors of Electrical World and Engineer:

SIRS:—Kindly allow me sufficient space to reply to the criticisms in the letter of Prof. A. S. Langsdorf, appearing in your issue of July 2, on my article on "Alternating-Current Wave Form Analysis," which appeared in the issue of May 28. His criticisms are, first, that "the tables of constants given are simply sines and cosines of multiples of five degrees"; and, second, that the method is essentially the same as that given in the appendix of Prof. D. C. Jackson's text-book on "Alternating Currents and Alternating-Current Machinery."

Replying to these in the inverse order, allow me to quote the last sentence of the opening paragraph of the article under discussion: "The greater part of the matter presented is not new, but the fact that methods of wave form analysis are not as generally known by active engineers as its importance warrants, may serve as a sufficient reason for presenting the following." I was familiar with the method given by Prof. Jackson in his text-book, but I believe that he makes no special claims to originality in connection with it, as the matter there presented has in all its essential features been worked over previously by a number of writers. Regarding the tables of constants, they were "simply sines and cosines of multiples of five degrees," as was perfectly evident from the article, and there was no intention on my part to give the impression that they were anything else. These constants were presented in a tabular form found convenient

for ready use, and were intended simply as labor savers, which they undoubtedly are, as anyone will soon discover who attempts to calculate them out from any trigonometric table.

The article was not written with the idea of giving anything particularly new, but was intended as a ready reference for busy engineers who are after results and who need a method which they can learn to operate quickly, which is reasonably accurate, and which involves the least amount of time and labor in its operation. For anyone having a great amount of harmonic analysis to do, a mechanical analyzer is undoubtedly the thing to use, but for the persons who make an analysis only occasionally, I believe the method outlined in my article of May 28 will prove as convenient as any of which I know, not excepting the one of Prof. Langsdorf to which he referred, and which I consider inferior to it in all three points mentioned above as desirable characteristics of a method suited to the given conditions.

PITTSBURG, PA. S. M. KINTNER.

Some Telephonic Experiments.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of June 25, 1904, where the humming telephone is described, the final period indicates how feeble alternating currents of high frequency are tapped from it. The writer has had occasion to obtain similar currents of low frequency and it was done by mounting a telegraph relay and sounder in close proximity with both their trunnions horizontal, on a thin wooden panel screwed against a wall. The play of the tongues of both relay and sounder was made vanishingly small, and the adjustment of the springs required considerable care; but when this was accomplished the device worked perfectly. To start the action, the panel was rapped with the knuckles; the ensuing noise was more of the nature of a rattle than a hum, and could be tempered somewhat by adjustment.

Another experience may be of interest: Being in an office close to the grade crossing of two railway tracks, and adjoining the post from which the engineers whistled for signals, the sound from the two sources would frequently interrupt telephonic conversation, and at times proved trying.

The difficulty was overcome by putting a second receiver in parallel with the first. The openings of both ears being closed in this manner, messages could be received without interruption; and the curious phenomena was observed that the voice of the distant speaker seemed to be in the middle of the head of the listener.

ALAMEDA, CAL. R. N. BLAKE.

"Working" Patent Inventions.

To the Editors of Electrical World and Engineer:

SIRS:—Your recent editorial regarding amending the patent laws to provide for "working" patented inventions has just come to my attention, and as I have given a good deal of thought to this question I cannot refrain from replying thereto.

That our patent system is better adapted to the peculiar conditions existent in this country than any foreign system it cannot be doubted by any one who will study the matter. In nearly all foreign countries, except Great Britain, patented inventions are required to be manufactured within two or three years of the dates of the patents. The result is that the larger number of patents become public property before they can be exploited sufficiently to comply with the law, for the costs of actually putting an invention on the market are usually considerable. I am told by a foreign patent agent that but a small number of patents last out their full terms, either because of failure to work or failure to pay annuities.

This wholesale invalidation results necessarily in making these foreign systems very unpopular with the masses, thereby putting a damper upon a large percentage of inventive talent. I understand that this unpopularity is so universal abroad that poor men give practically no thought to the creation of inventions, believing it to be useless except for the well-to-do class. It costs so much to keep a patent in force, and they have heard of so many instances where poor men have been compelled to let their patents lapse for want of funds to pay taxes and exploitation expenses that they consider a patent to be too high a speculation for them to engage in. I consider this unpopularity of their patent systems a great loss to foreign countries, as the classes of moderate means (not, of course, the poorest classes) are the very classes among whom are found a great many embryo inventors who need but little encouragement for their development. It must be conceded that a patent system is successful just in proportion to the degree in which it develops the latent inventive talent in the territory which it covers, and any system which falls short of making the most out of the people it covers is defective to a more or less degree.

I do not know a measure that would work more dire results to our patent system than a general requirement for working or for the annual payment of taxes to keep patents in force. The thing which makes our country a veritable hotbed of invention to-day is the popularity of our patent system, and it is its liberality that makes it popular. The masses, particularly, are reached by the present law, and any change in the law that would work to their injury would surely result in the loss to the country of a considerable portion of its potential creative talent.

Another objection to such a measure lies in the fact that it would very greatly increase the number of unexploited inventions that have become public property. A little reflection as to the fundamental basis of a patent system will show the evil results that must follow this. I take it that it is conceded that a system which grants private monopolies must have for its main *raison d'etre* the public good, and that, therefore, the real excuse for the existence of a patent system is not that it rewards inventors, but that it stimulates invention and industrial investment. Now this matter of investment must undoubtedly be considered the most important desideratum, as no amount of inventive productions would enable this country to fight the fight for primacy in the industrial arts that is inevitably ahead of it if such productions be unexploited. It is, therefore, the prime object of our patent laws to increase investment in new projects.

Now it would appear at first blush that this augmentation of industrial investment is exactly what would follow a working requirement in the law, but this, it is my firm conviction, is but the apparent result. The real result, besides making the system unpopular, as already set forth, would be to retard or forever postpone the exploitation of a great many useful inventions, for experience has shown that when an unexploited invention becomes public property—that is, when it becomes nobody's particular business to exploit it—it lies dormant indefinitely. New inventions, if successful at all, almost invariably have to be actually forced on the public, and therefore no man will invest capital to test their commercial value unless he has the assurance of a monopoly for a sufficient length of time to enable him to reap the reward due him for the outlay and the risk. In other words, I maintain that it is a positive detriment to public interests to dedicate an unexploited invention to the public, for in no surer way can its exploitation be killed. I am so strongly of this view that I would favor extensions in those cases where the absence of vested intervening rights would permit it to be done equitably.

In taking this position I am not unmindful of what you say regarding the practice of some firms in taking out patents to simply keep other manufacturers out of possible fields of rivalry and holding such patents, unexploited, to the ends of their terms. This practice, if really detrimental to the public, results in such comparatively infinitesimal harm that it ought never be made the excuse for making such a radical change in our patent law as you seem to favor.

I am forced to admit, however, that there is a class of cases where a working requirement would apparently do more good than harm. I refer to those cases where foreign citizens take out United States patents and manufacture abroad, and export the articles to this country. In these cases this country undoubtedly loses in industrial wealth by not requiring manufacture in this country, and I cannot see that serious harm would result from a law that would require manufacture here within a reasonable period of time, say five years, from the first importation. It would be unsafe to go farther than this, as to require all foreign holders of our patents to manufacture here in every instance would certainly make our system unpopular abroad, a thing we should avoid if possible for the obvious reason that the more patents we grant the more manufacturing will we stimulate.

In this connection I should like to call your attention to a very remarkable report made by Mr. Story B. Ladd for the last census. This bulletin presents a most convincing array of statistics, which show not only that there has been a close approximate parallelism between the growth in patents and the growth in manufactures; but also, and more significant still, that with each succeeding decade the quantity of material handled and the quantity of product turned

out per wage-earner has increased. The study of this subject produced such a profound effect on this statistician that he was moved to incorporate in his report, in referring to the clause in the Constitution on which the patent laws are based, this enthusiastic opinion: "The germinating principle of this clause of the Constitution has vitalized the nation, expanded its powers beyond the wildest dreams of its fathers, and from it more than any other one cause has grown the magnificent manufacturing and industrial development which we to-day present to the world."

In your article you also complain of the many "unsuccessful" patents. I have been for years considering how best to obtain statistics as to what proportion of patents cover successful devices, but the grave nature of the subject precludes satisfactory results. It is difficult at the outset to define "success" when applied to patents. Many confuse it with operativeness or mechanical success, and others have such an exalted idea that only those patents which make fortunes for their owners are successful. It is not fair, it would seem, to say that only those inventions which are put on the market in paying quantities are successful, because the successful exploitation of a new thing requires more than simply that a need exists for it, for no matter how much need exists for a thing there is much extensive work to be done to create a demand for it. It would seem, therefore, that it is but fair to say that an invention is successful—not merely mechanically operative, but *successful*—if tests demonstrate beyond a reasonable doubt that if backed by capital to an amount commensurate with its nature and by reasonable energy it would pay to push it.

WASHINGTON, D. C. CHARLES D. DAVIS.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Repulsion Motor.—CARTER.—The conclusion of his serial on the repulsion motor. He thinks that the simple repulsion motor, while possessing in a general way the characteristics required of a railway motor, would hardly be suitable for tramway or ordinary railway work. Some use might be made of it for long-distance, high-speed work on approximately level track, where the high rate of acceleration is of little importance and the changes in train resistance due to grades are partially compensated by the changes of windage due to variation of speed. For ordinary traction work, however, the torque curve approaches the horizontal too quickly; that is, the torque reaches a value which changes but little with the speed before it has become a sufficiently small fraction of the starting torque. If the repulsion motor is to be used for railway work, it must be robbed of much of its simplicity. The torque must be brought to a value suited to the grade by shifting the brushes with reference to the poles, by varying the terminal voltage, or by introducing a suitable series current into the armature through a second set of brushes. Whichever complication is employed, it is by conscious effort on the part of the driver, rather than in virtue of the motor characteristic itself, that a varying train resistance is taken care of, so that driving requires greater skill than when the direct-current series motor is employed. The Winter-Eichburg motor shows no advantage over the simple repulsion motor in this respect. The ideal railway motor should have a speed-torque curve at constant voltage something like

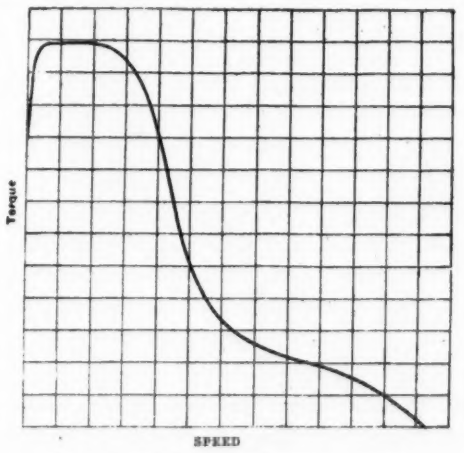


FIG. 1.—CURVE OF REPULSION MOTOR.

Fig. 1. The controlling apparatus would then be reduced to little more than a reversing switch. There is nothing innately improbable in such a characteristic being obtained in an alternating-current motor and it is, therefore, well to keep the ideal in view when dealing with such motors.—Lond. *Elec. Rev.*, July 1.

Contact Resistance of Carbon Brushes.—A note on experiments made by Schenkel on the resistance of carbon brushes in contact with a rotating bronze ring. His conclusions are that, at constant brush pressure and constant speed, the product of the current density and contact resistance is constant; if current density and brush pressure are kept constant, then the contact resistance is nearly independent of the speed, provided the ring is perfectly centered. If, however, this condition is not fulfilled, the brushes begin to vibrate and the contact resistance rapidly increases with the speed; the contact resistance diminishes with the brush pressure.—Lond. *Elec.*, July 1.

REFERENCES.

Direct-Current Generator Armature.—WAGNER.—An illustrated description of the connections and construction of the armature winding of a direct-current generator of standard design. The armature has coils formed from copper strap and the winding is of the multiple-circuit type, in both of these respects typical of the larger sizes of direct-current armatures.—*Elec. Club Jour.*, July.

Induction Motor.—PARKER.—An article in which he gives an induction motor diagram which shows not only the phases and magnitudes of the rotor and stator currents, but also the various fluxes operating in the motor.—Lond. *Elec. Rev.*, July 1.

Electric Machine Design.—LOEWY.—The conclusion of his illustrated serial on progress made during 1903 in the construction of electric machines. In this installment he deals with alternating-current commutator motors.—*Zeit. f. Elek.* (Vienna), July 3.

POWER.

British Power Plant.—The first part of a detailed illustrated description of the Carville power house, which supplies current for lighting and power and also for the 37 miles of railway track (mostly double-track) of the North Eastern Railway Company. It is said to be the newest and perhaps the finest specimen of electric power station design at present existing in Great Britain. In the present installment the equipment of the boiler house and the engine room is described. The present capacity is 12,000 kw, made up by two 2,000-kw and two 4,000-kw Parsons turbo-generators, the steam consumption being guaranteed less than 18 pounds per kw-hour for the large sets and 19 pounds for the small sets. These figures have actually been obtained under working conditions. The latest improved type of Parsons steam turbines are installed, forced lubrication to the bearings being used, with arrangements for water circulation. Mechanical governors are provided, which allow the normal speed (1,200 r.p.m.) at any load up to the maximum to be varied by 5 per cent. The adjustment of the governors is preliminarily effected by hand at the turbine, while exact speed is obtained by electric control at the switchboard. In the latter device the ratchet gear is operated by a solenoid, the current for which is taken from the station battery. The steady speed of the turbines is specified not to vary more than 3 per cent. between no load and normal load, and not more than 5 per cent. between no load and maximum load, and when running at maximum load the variation of speed when ⅞ of the load is thrown off, must not exceed 6 per cent. Under ordinary conditions of steam pressure and vacuum, the large turbines are each capable of dealing with 5,000 kw for one hour, or 5,500 kw momentarily; the corresponding figures for the smaller machines are 2,300 and 2,500 kw. In addition to the ordinary governors, mechanical safety governors are provided, which cut off steam when the speed rises to 1,400 r.p.m., and these may be oper-

ated by hand both at the floor and the basement levels. In the 4,000-kw sets all the blades in the high as well as the low-pressure chambers and on both the stator and the rotor are laced. The alternators are of the revolving-field type, directly connected to the rotor shaft of the turbine. At normal speeds they generate three-phase currents at 5,750 volts and 40 periods per second. For excitation a two-pole, direct-current machine is mounted upon the end of the shaft remote from the turbine, its armature being connected to the field windings of the alternators without the interposition of any regulating rheostat. The field of the exciter is separately excited from the battery or from the motor-generator at 100 volts, and the regulating rheostats are inserted in this circuit. The e.m.f. of the exciting armature is 100 volts. Carbon brushes are employed on these exciters and up to the present have not caused the slightest trouble.—Lond. *Elec.*, July 1.

Hydro-Electric Plant.—HERZOG.—A fully-illustrated description of the hydro-electric station, at the Jonage Canal in Cusset, near Lyon, which supplies Lyon and the neighborhood with electric current. The water available is normally 100 cubic meters per second and the fall 14 meters. At any time 14,666 hp are available. There are 16 turbines connected to three-phase generators. For the underground distribution network, with cables having paper insulation, a voltage of 3,500 was chosen. Each of the 16 generators has a capacity of 900 to 1,000 kw and generates three-phase currents of 3 × 200 amp. at 3,500 volts, with a frequency of 50, when running at 120 revolutions. The efficiency is 5.2 for a power factor equal to unity and 94.6 with a power factor of 0.74.—*Elek. Bahnen*, No. 11, June.

REFERENCES.

Softening Feed Water for Boilers.—WIESLER.—An article in which he gives rules for analyzing the salts dissolved in the water in order to determine the additions necessary for softening. In a test made for several months 200 cubic meters of water were daily softened and there were used daily 27 kg. of CaO and 6 kg. of Na_2CO_3. The cost of the purification of the water was 37½ cents per day, or 18¾ cents per cubic meter.—*Dingler's Poly. Jour.*, June 25.

Industrial Locomotives.—GAIRNS.—The first article of a serial on industrial locomotives for mining, factories and similar uses. This part deals with steam locomotives.—*Cassier's Mag.*, July.

TRACTION.

Electric Towing System on the Teltow Canal.—An account of trials made with an electric locomotive for towing boats through the Teltow Canal. The length of the line is 1.3 km. On the towpath a track of old rails was laid having a gauge of one meter. Direct current was supplied from an auxiliary power plant, the voltage being held constant at 550. The electric locomotive has a truck in front, both axles of which are driven by an 8-hp series motor; at the rear the locomotive has a free steering axle. A double trolley is used to prevent any disturbances in a magnetic observatory in the neighborhood. The rope for towing boats passes through an eyelet at the top of an arm of 2.5 meters length on the locomotive and from there to the winding drum. The arm may be raised or lowered by means of a 1-hp motor. The winding drum is revolved by a 2½-hp motor, through worm gearing. The winding drum is not rigidly fixed to its axle, but connected with it by means of a friction couple which begins to slip when the pull of the rope amounts to 1,150 kg. All motions are, therefore, accomplished by electric power, and the locomotive engineer has to attend three switches which control the driving motors, the winding drum and the position of the towing arm respectively. The engineer's cabin is at the front of the car and closed on all sides by windows. The weight of the locomotive is 6.5 tons. Experiments were made with four boats weighing empty 140, 100, 60 and 50 tons, and carrying a useful load of 440, 320, 190 and 154 tons respectively. The main results are shown in the following table:

	4-km.	4.5-km.	5-km.
Tractive resistance in kg. per ton of useful load.....	0.85	1.035	1.34
Tractive resistance in kg. per ton of displacement....	0.6	0.79	0.97
Rate of work in hp done by locomotive per ton of useful load	0.0127	0.0174	0.0248
Rate of work in hp done by locomotive per ton of displacement	0.010	0.0134	0.0186
Power in kw consumed by locomotive per ton of useful load	0.014	0.021	0.0284
Power in kw consumed by locomotive per ton of displacement	0.0112	0.0155	0.0209

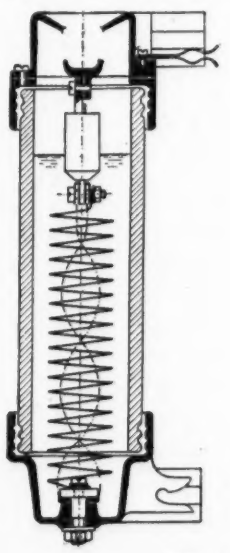
(The article also gives the energy consumption in watt-hours per ton of useful load and of displacement, but some of the figures given here do not agree with the other figures.) The efficiency of the locomotive was about 65 per cent. for 600 to 1,100 tons of useful load. The most economical speed is about 4 km. When the boats were near to the bank of the canal the tractive resistance increased by about 15 per cent.—*Elek. Bahnen*, No. 12, June.

REFERENCE.

Alternating-Current Traction.—See the abstract on repulsion motor under "Dynamos."

INSTALLATIONS, SYSTEMS AND APPLIANCES.

High-Tension Fuses.—COLLISCHONN.—An account of a series of experiments made by a German manufacturing company to develop a fuse for high-tension circuits. The difficulty is that when the fuse melts metallic vapors are produced which conduct the current and thus form a bridge between the terminals of the fuse wire, so that an arc is formed; the circuit is, therefore, not interrupted, and the arc burns the contacts and may spring over to other metal pieces in the neighborhood. The main problem is, therefore, to extinguish the arc immediately. Experiments were first made in which the metallic fuse wire was covered with a thick layer of a tenacious cable compound. Such "cartridges" gave excellent results with 400 kw at 10,000 volts, but were absolutely useless at greater capacities since very strong explosions then occurred. It was then tried to use a fuse wire in oil. The results were good as long as a large basin with oil was employed, but when it was tried to design the fuse of convenient size having the form of a cylindrical glass tube of limited dimensions, filled with oil and containing the fuse wire, explosions again occurred. The oil was thrown out vehemently and the glass tube broken in many pieces. The vehemence of the explosion may be judged from the fact that glass tubes of 10 mm. thickness were broken and sheet iron of 5 mm. thickness was bent like a piece of paper. The conductivity of the glass developed may be judged from the fact that at 5,000 volts a spark springs over a distance of about 70 cm. Full success was finally obtained by the arrangement shown in Fig. 2, the features of which are that the fuse wire is placed in a chamber closed at the top and suspended at the bottom into oil; the fuse wire melts in air, but the explosive gases are driven downward into the oil. A glass tube is closed at both ends by metallic covers. The top cover has some holes for pouring the oil into the tube. The fuse wire is contained in the melting chamber proper, which is made of strong metal, as shown in Fig. 3. The



FIGS. 2 AND 3.—HIGH-TENSION FUSES.

chamber has a pin-hole in the top through which the fuse wire enters, but is open at the bottom. The melting chamber is placed in the oil. At the lower end of the fuse wire a connecting piece is provided which is connected electrically with the lower end of the glass tube and is also connected to this end by means of a spiral spring, which keeps the fuse wire in tension. The fuse wire itself is not in oil. When it melts the spiral spring draws the lower end of the fuse wire readily downwards and the explosive gases rush into the oil, where they are immediately cooled. The result is that no arc can be formed. This fuse is stated to stand a continuous overload of about 50 per cent. of the normal current and a short overload (about 5 minutes) of about 70 to 80 per cent. When loaded in cold condition with double the normal current, it melts within less than two minutes. Several such fuses have already been installed in practice, among them fuses for 50 amp. and 10,000 volts for a London station.—*Elek. Zeit.*, June 9.

Poplar.—An account of the extensions of the Poplar electric supply undertaking. The area is a long, narrow strip, with docks at one end and important industrial concerns at the other. The existing supply system is a direct-current one, with a generating station about midway between the two ends. Since the space in the plant is limited some of the small generating sets are to be replaced by others of much greater capacity. There are at present two 100-kw, two 200-kw and two 500-kw generating sets, giving 460 to 500 volts, the pressure at the consumers' terminals being 230 volts. There is already a 1,500-volt, continuous-current supply to the Isle of Dogs, the intention being to couple three of the generators in series and work them in conjunction with a reducer at a sub-station. Nearly all the load of this high-tension system is due to motors and occurs mostly in the daytime. A large demand is, however, occasionally made during the night. The alterations to be carried out in the station consists in the removal of two 100-kw sets and the substitution therefor of two 1,000-kw turbo-generators. The steam turbines are of the Parsons type, while the generators will give 6,000 volts between phases at a speed of 1,500 r.p.m., the frequency being 50 periods per second. There will be two sub-stations, each designed to accommodate eight converters, although only one 250-kw and one 500-kw machine are to be installed in each to begin with. The particular converter to be employed is of the LaCour pattern, and is really a hybrid of a motor-generator and a rotary converter. Each set consists of two distinct machines, one a three-phase induction motor and the other a direct-current generator, and both are rigidly connected together on a bed-plate. The peculiarity of the machine is that the winding of the rotor is connected electrically to that of the continuous-current generator, the contention being that as a certain amount of energy is conveyed electrically from one machine to the other, the efficiency is higher than that of an ordinary induction motor-generator. Current from the high-tension transmitting lines at 6,000 volts will be taken to the stator of the motor and the voltage of the generator will be 470 to 530. One of these converter sets with a capacity to 500 kw will also be put down at the generating station, so that at times of light loads only one generator, either continuous or alternating, will be necessary to run for both systems. —Lond. *Elec.*, June 24.

The Use of Booster During Discharge of a Battery.—DOBLET.—While boosters are generally used for charging a battery, they are disconnected during discharge and the voltage of the battery is varied by varying the number of cells. This has the disadvantage that the voltage can be regulated only in steps of two volts and there are always a number of cells which are less discharged than the balance, and there are even cells which are practically never discharged, resulting sometimes in sulphatization. To overcome these disadvantages, the author uses the booster during the discharge of the battery. For instance, in order to charge a battery of 300 volts from 220-volt motors, the booster has to give $80 + X$ volts; for this purpose the booster consists of a motor of 220 volts coupled to a generator of $80 + X$ volts. If the battery is discharged through this machine, i. e., if one makes the overvoltage $80 - X$ instead of $80 + X$ volts, the generator becomes a motor and the motor a generator. In varying the excitation either in the generator or in the motor it is possible to vary the discharge current, hence the voltage, as accurately as desired. All cells are then discharged simultaneously to the same degree. During operation of the battery in parallel with a generator, it is possible to regulate the output of each so that the generator always runs with the most favorable load, and as soon as the total load of the station diminishes below this value, the battery is charged again.—*L'Eclairage Elec.*, July 2.

ELECTRO-PHYSICS AND MAGNETISM.

N-Rays.—BICHAT has observed some properties of N-ray emission which show a strict analogy to phosphorescence. Meyer has made further experiments confirming Becquerel's observation that there is a true action of anæsthetics, such as chloroform, upon the emission of N^1-rays. J. Becquerel has found that in all cases where a surface emits N-rays normally, it emits N^1-rays tangentially and vice versa. This fact establishes a close correspondence between the emission and absorption of these rays which leads him to some generalizations. A brick exposed to the sun emits N-rays normally and N^1-rays tangentially. A patch or cross of the phosphorescent sulphide alternately brightens and darkens as successive surfaces of the brick are exposed to it. When a body is compressed, it emits N-rays from the compressed surface and N^1-rays from the surfaces perpendicular to it. The author lays down the following general rules: The rays produced by the compression of a body (N-rays) have the property of increasing the sensibility of vision, and produce, on a surface capable of storing them, the same effect as regards radiation as does a compression normal to that surface. The rays produced by the stretching of a body (N^1-rays) have the property of diminishing the sensibility of vision, and produce on a surface capable of storing them the same effect as a tension normal to that surface. The author seeks the origin of the rays in the vibrations of the molecules attaining a new position of equilibrium. In looking for some regularity in the spectrum of the rays, he found that Blondlot's values may be arranged in two series, one of them containing multiples of 2.9 $\mu\mu$, the other containing simple fractional multiples of 4.9 $\mu\mu$.—*Comptes Rendus*, May 30; Lond. *Elec.*, June 24.

Alloys of Bismuth and Tin.—LAWS.—An account of an experimental investigation of the magnetic susceptibility of the alloys of bismuth and tin. The following general rule holds good concerning the electric and magnetic properties of these alloys. When a very small amount of tin is added to pure bismuth, a considerable change in all the physical properties is produced. On the other hand, the addition of bismuth to pure tin is always accompanied by a gradual change in the physical properties, the metal, so long as it does not contain a considerable excess of bismuth, behaving as though it were a simple mixture of the two constituents.—*Phil. Mag.*, July.

ELECTRO-CHEMISTRY AND BATTERIES.

Refining Gold.—WOHLWILL.—A second article on his electrolytic process of gold refining in which he uses an electrolyte of gold chloride with an excess of free hydrochloric acid at elevated temperature. The process may be applied to separating the gold from gold alloys. The condition of the application of the process is that either all constituents of the anode are dissolved under the influence of the current or the formation of insoluble compounds at the anode does not cause any interruption in the solution of the other constituents, even at a high current density. The gold anode must, therefore, not contain too much silver and lead, which would prevent the continuity of the dissolution of the anode. In the Philadelphia Mint the process is limited to bullion having a fineness not less than 0.0940 gold. The author remarks that this does not represent the limit, but is due to the fact that in Philadelphia a temperature of 50 to 55° C. is used; in this case the gold is obtained in a soft condition. If the electrolyte is heated to 65 or 70° C, which he considers the normal temperature, the current density at the anode can be increased to double that at the lower temperature without causing the development of gaseous chlorine at the anode or falling off of gold from the cathode. If the silver chloride formed at the anode is scraped off at periodic intervals, it is easy to recover within 24 hours directly as chemically pure gold the greater part of the gold contained in alloys with 15 per cent. of silver. Since the good operation depends on the presence of sufficient gold in the solution, and since more gold is deposited on the cathode than is dissolved from the anode, it is necessary to add continuously gold to the electrolyte; for this addition, of course, the alloy to be refined is used. The author gives numerical data on the operation of the process and discusses at some length the question of interest on gold stored in the solution and in the cathode plates.—*Electrochem. Ind.*, July.

Pulverization of Copper Anodes.—FISCHER.—An account of an experimental investigation. If two copper wires of 1 mm. diameter are suspended to a length of 10 mm. in sulphuric acid of maximum conductivity, and an e.m.f. of 20 volts is applied, the anode wire is pulverized and dense clouds of a dark dust are developed, remaining suspended in the electrolyte for a long while. This dust consists of metallic copper. At the same time copper goes into solution as cupric sulphate. If the voltage of 20 is not immediately applied, but the e.m.f. is gradually raised, the pulverization of the anode is preceded by a condition of the copper anode, which is very similar to the electrolytic valve action of the aluminum anode. The phenomena are discussed in detail and the influence of temperature is investigated.—*Zeit. f. Elektrochemie*, June 24.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Single-Phase Energy Meter.—An illustrated description of improvements made in the Baltault meter for single-phase systems. A laminated electromagnet core is provided in form of a U, and the two ends of the arms are also constructed in U form. The shunt

windings are placed on the two arms of the main U; above these coils is placed a magnetic bridge, as shown in Fig. 4. The series coils of thick wire are placed on the arms of the two small U's, so that in any instance the polarities of the different magnets are such as shown in Fig. 5. The combined action of the different coils develops eddy curcents in a copper disc above the electromagnet. These react on

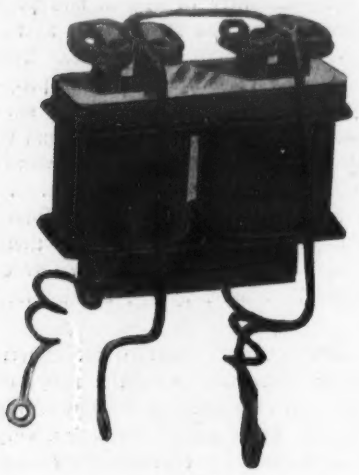


FIG. 4.—MAGNETIC BRIDGE.

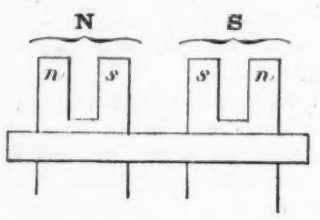


FIG. 5.—DIAGRAM OF POLARITIES.

the fluxes of the electromagnet so that a torque is produced which moves the needle on the dial of the meter. Since this torque is the result of the combination of the fluxes of the series and of the shunt coils, it is proportional to the energy to be measured. The angular speed of the disc is rendered proportional to the torque by adding a permanent brake magnet, which acts on the disc. Formerly the arrangements were so made that the air-gap could be changed in order to vary the braking action. Now the air-gap is held constant and for regulating purposes the following two devices are used: The permanent magnet can be moved in the direction of the radius of the disc so that a greater or smaller flux of the magnet acts on the disc. There is also provided a small iron piece which may be brought nearer the one or the other pole of the electromagnet, resulting in lack of symmetry of the field and in a small torque. If the meter shall be exact for a circuit with phase difference, it is necessary that the fluxes produced by the series and shunt coils respectively be in quadrature. This condition is fulfilled by placing on the poles *N* and *S* short-circuited windings which surround them completely. The theory of this device is given. A 500-amp. meter of this type is started by a single lamp of 16 cp.—*L'Industrie Elec.*, June 25.

Thermo-Galvanometers and Barretters.—FESSENDEN.—A communication with reference to Duddell's recent paper. The writer states that he constructed an instrument of this type in 1898, which was quite sensitive, but its time period was rather large. Later the efficiency of the heating coil was increased by using two oppositely-placed small parabolic reflectors, with the heating coil at the focus of one, and the suspended thermo-junction arranged just outside the focus of the other. This was found to be of considerable advantage, but the time period was still too long. The thermo-junction was later made by dipping two fine wires of copper and constantan or German silver into an electrolyte and electrolyzing them so as to produce an extremely long, fine point, resembling a bee's sting under the microscope. These two fine points were held in clamps with a micrometer adjustment, and electrically welded together under a microscope with a voltage of about two volts and a resistance of about 100,000 ohms in series. The other ends of the wires were bent together and soldered. This thermo-junction had an extremely small heat capacity and proved very much more efficient. He formerly applied this in connection with electromagnetic radiation, but abandoned it for the barretter method, known from his patents. The latter method enables one to measure alternating currents down to 0.1 microampere with a resistance of only 30 ohms, the reading being absolutely proportional to the energy observed. Its heat capacity is so small (about 0.1 erg) that on connecting a telephone in circuit with a barretter and battery and speaking with the mouth placed six or eight inches from it, the speaking is produced clearly and distinctly in the telephone, owing to the heating and cooling of the barretter by the compression and expansion of the wire to the sound waves. Kennelly suggests that the barretter should be used as an absolute standard for measuring the intensity of sounds. In this experiment the wire should be straight and at right angles to the direction of the sound waves. A still better result can be obtained by placing the barretter at the apex of an ear trumpet. This phenomenon is reversible. The hot wire of the barretter is mounted in an ear piece, similar to that used for photographic tubes. By attaching one terminal to a vertical wire and the other to a ground wire, it is possible to read wireless signals, the heating of the barretter causing the air to expand, affecting the ear directly. By running wires from one terminal to the head and from the other terminal nearly to the ground, it is possible for the experimenter to walk around at a distance of several hundred yards from the sending station and to hear everything that is being said.—Lond. *Elec.*, June 24.

REFERENCE.

Power Factor Meter Connections.—A description, illustrated by diagrams, of methods of connecting a power factor meter to three-phase circuits.—*Elec. Club Jour.*, July.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Propagation of an Alternating Current Along a Telephone Cable.—FLEMING.—An abstract of a (British) Physical Society paper on a model illustrating the propagation of an alternating current along a telephone cable and on a simple theory of the same. For the presentation of the elementary theory of the phenomena he considers the expression in terms of complex quantities (Steinmetz's symbolic method) preferable to the use of ordinary trigometrical analysis, since the time element is thereby eliminated. To represent graphically the distribution of potential in a cable at any moment, he has devised a model which consists of a steel axis, in which are keyed a number of wooden discs grooved on the edge. These are set on the shaft eccentrically and the eccentricity of the wheels diminishes in geometrical progression. Each eccentric is shifted backward in phase compared with its preceding neighbor by an equal angle, and these eccentricities and phase angles can be varied. Each eccentric wheel is embraced by a long string, the ends of which are attached to metal blocks which slide up and down on a steel wire. These strings are all of equal length. When the axis carrying the wheels revolves, each block moves up and down with a nearly simple harmonic motion, but the amplitude of that motion decreases from block to block, and moreover the phase of the motion of each block is delayed behind that of its next preceding neighbor by an equal amount. Hence, when the axis is turned round, the blocks, of which there are 48, are arranged in a periodic curve of decreasing amplitude and moved up and down in a manner which imitates the propagation of a wave of alternating current or potential along a cable. Heaviside's criterion of the distortionless propagation of a wave of electric current is applied by the author to the case of a long submarine cable, and it is shown how far removed such a cable is from being distortionless. He discusses the remedies which have been proposed and shows that it is hopeless to expect any real advantage merely by bringing the iron armor closer to the cable conductor, but that a large reward awaits any inventor who can bestow upon any submarine cable inductance up to 300 or 400 henries per knot, without at the same time increasing appreciably the usual capacity of 0.3 microfarad per knot. He thinks there is no difficulty in applying Pupin's method of inserting inductance coils in series at intervals to subterranean telephone trunk lines.—Lond. *Elec.*, June 24..

REFERENCES.

London Telephone Exchange.—An illustrated description of the new Holborn telephone exchange, in which the National Telephone Company has made another step toward the entire conversion of the London telephone service to the central battery system.—Lond. *Elec. Rev.*, July 1.

Symbols in Telegraphy, Telephony, etc.—BAUMANN.—An article in which he proposes a system of symbols for the various kinds of instruments and apparatus used in telephony and telegraphy, signals, etc.—*Elek. Zeit.*, June 2.

Telephone.—GRACE.—A fully-illustrated description of the development of modern telephone apparatus and equipment of exchanges.—*Elec. Club Jour.*, July.

Telephony.—WEBB.—An article on telephony in the United States.—*Cassier's Mag.*, July.

MISCELLANEOUS.

Physiological Effect of Radium Emanation.—BOUCHARD, CURIE, BALTHAZARD.—An account of experiments on the effect of radium emanation on mice and rabbits. The confinement of the animals in an atmosphere containing radium emanation, but maintained at a

constant composition by the renewal of the oxygen and the observation of the carbonic acid, led to death in a few hours, the cause of death being inflammation of the lungs. The tissues of the animals which had succumbed became highly radioactive, more especially the fur and the lungs. Injection of fluids containing the emanation had no toxic effect.—*Comptes Rendus,* June 6; Lond. *Elec.,* June 24.

REFERENCES.

Laboratory.—An illustrated description of the Merchant Venturers' Technical College at Bristol.—Lond. *Elec.,* July 1.

Ohm.—An account of his life and work, with reference to the fiftieth anniversary of his death on the 6th of July, 1854.—*Zeit. f. Elek.* (Vienna), July 3.

New Books.

MODERN ELECTRICITY. By Prof. James Henry, M.E., and Karl J. Hora, M.Sc. Chicago: Laird & Lee. 355 pages, 160 illustrations.

Though containing a fair amount of elementary instruction well arranged, this book is apt to prove misleading to those depending upon it for information concerning electrical engineering in general. Much of the matter contained is treated in a manner to render the book attractive to those for whom it was especially intended, the apprentice and the artisan. Its value, however, is rendered practically nil by reason of the incorrect statements with which the book bristles.

To lack of care, perhaps, may be attributed the fact that the so-called two-phase winding, shown in Fig. 64, contains twice as many turns in one quarter section as in another, and that the supposed three-phase winding of Fig. 67 is unsymmetrical throughout; but one is unable to find the cause for the statements made in discussing direct-current generators, that "Fig. 40 shows a stationary direct-current armature, and Fig. 39 its rotary magnetic field," when in reality Fig. 40 shows the primary and Fig. 39 the secondary of a type C Westinghouse induction motor. The book contains the catechism feature, one of the questions being "What kind of winding is used on the fields of a street car motor, and why?" The answer is: "A series winding, because it furnishes a current of constant strength." Again, in discussing the magnetism of dynamos, these questions are asked: "What is the leakage coefficient? A.—The ratio of the lines going through the field to those going through the armature. Q.—What does it mean when it is stated that the leakage coefficient of a machine is .89? A.—It means that the number of lines of force passing through the armature are 89 per cent. of those passing through the field." Evidently the fact that the answer to the first question implies a coefficient greater than 1 has not been considered. On page 120 we are told that "A good insulating material is not necessarily desirable for use in a condenser, because it may have a great specific inductive capacity"! and that "condensers are mounted in the bases of some induction coils where they serve to increase the induction." One learns from Section 140 that "Polyphase motors are usually called induction motors and that several of them may be run in parallel, as they are easily synchronized." Under "Practical Points" is found the statement that "In paralleling compound-wound generators, the positive and negative generator main switches must be thrown in, then the equalizer switch"—the worst method one could possibly devise. As a means for misleading those it pretends to guide, we can commend this work. The book is gotten up in a pretentious manner mechanically, evidently to appeal to the untutored. It is little less than an outrage that such a work should be offered to the undiscriminating public for which it is evidently intended. In catering to this public an author should be more than usually careful and conscientious in his teaching. In this instance the dense ignorance of the authors is accompanied by slothful carelessness. It would be interesting to know in what school one author is a professor, and what justification the other author has to the title "expert electrical engineer."

THE DYNAMO. By C. C. Hawkins and F. Wallis. London: Whittaker & Co. 925 pages, 413 illustrations. Price, $4.00.

Seven years have elapsed since the second edition of this work appeared, so that the work of revision naturally involved the addition of a great amount of material as well as the discarding of much that has been made obsolete by the advancement of dynamo design and construction during the long interval between the two editions. The present edition gives evidence that the author (Mr. Hawkins seems to have made the revision alone) has not shirked his task in the least. The chapters dealing with fundamental principles and laws have been elaborated to considerable advantage; the discussion of designing practice has been thoroughly revised and five new chapters have been added.

The author follows the usual but rather academic method of basing his treatment of armature windings on conductors and conductor pitch instead of the more convenient and less confusing method of considering "coils" or (in windings having one "turn" per commutator segment) pairs of conductors and the pitch of the leads at the commutator. There is no reason whatever for considering the front and back pitches of the conductors at the armature core if each coil or element be considered. The discussion of armature shafts is particularly complete and sound; that of formed armature coils, in the same chapter, is also very satisfying, although it might have been extended advantageously to the reader. Chapters XIV and XV, on field magnets and field ampere-turns, contain the most practical and sensible analyses of these subjects that the reviewer has thus far seen. Chapter XVII, on armature reaction, contains some extremely useful material, with some that is academic from the standpoint of a designer; as it is in large measure preparatory to the discussion of commutation in the succeeding chapter, however, its academic features are not entirely superfluous.

The treatment of alternator design and construction, which is almost entirely new in this edition, is excellent, and the large number of references to other sources of information increases the practical value of the work considerably. The discussion of alternator armature reaction is especially good, but rather too much condensed for use by anyone who is not already experienced in practical designing. The final chapter on the "Description of Typical Dynamos" is chiefly perfunctory, only the barest general information being given as to most of the machines mentioned.

The author's style of exposition is somewhat mathematical in many places, but since this is a text-book rather than a designer's manual, and the book has grown to nearly a thousand pages even with condensation style, it is scarcely fair to expect more expanded treatment. On the whole, the book is highly creditable and reliable; the points of excellence vastly outnumber the weak spots.

STATIC ELECTRICITY. By Hobart Mason. New York: McGraw Publishing Company. 152 pages, 63 illustrations. Price, $2.00.

This volume, though suitable for a text-book, treats static electricity from the point of view of the engineer and not the physicist. The subject is thoroughly covered, nothing essential being omitted. The treatment is much more elaborate than what is usually found in textbooks. After having dwelt at some length upon the theory of the electrostatic field and capacity in general, the author describes the apparatus used in electrostatics and static generation for high potentials. The matter is presented in a readable form and should prove highly interesting and instructive to engineering students, who, in fact, usually are inclined to look upon this part of physics as just so much theory, which has no direct bearing on engineering. Any treatment which will lead to an understanding of the close connection between electricity at rest and electricity in motion should be welcomed by those endeavoring to instruct students in engineering, because most textbooks now available cause the student to believe that electricity obtained from a Holz machine is of an entirely different nature from that gotten from an Edison bipolar generator. The book is devoid of the superfluous array of mathematical symbols usually found in treatises on electrostatics, although a few equations are used to good advantage where necessary.

THE APPLICATION OF ELECTRIC MOTORS TO MACHINE DRIVING. By Andrew Stewart. London: S. Rentell & Co. 52 pages, 19 illustrations.

In this little book the author presents a clearly written outline of the advantages of electric motors over steam engines, and supplements his arguments with test data actually obtained in practice. That many small engines driving isolated machines require from 125 to 200 pounds of steam per hour per useful horse-power developed may seem doubtful, but when one considers the losses due to leaky valves, uneconomical points of cut-off and to condensation in long pipe lines, and remembers that such engines are frequently idle a large portion of the time, the estimates of steam consumption are not at all unreasonable. The chief value of the book lies in the information which it contains concerning the energy consumption and cost of operation of existing installations.

ESSAIS INDUSTRIES DES MACHINES ELECTRIQUES ET DES GROUPES ELECTROGÈNES. By F. Loppe. Paris: Gauthier-Villars. 283 pages, 129 illustrations. Price,

Having described the various instruments for making electrical and mechanical tests, including liquid, carbon and metallic rheostats, absorption and transmission dynamometers, the author discusses the determination of the rise in temperature of the different parts of a machine, the calorimeter method of ascertaining the losses of a machine, the stray loss method of finding efficiencies and the opposition method of conducting a test when proper machines are available. He then describes in detail the tests to be made on direct and alternating-current machinery. The author very properly places great stress on the advantages of the opposition methods, and outlines the tests according to Hopkinson, Lord Rayleigh, Kapp, Potier, Hutchinson and Blondel for direct-current machines, and Blondel's transmission dynamometer method for alternating-current machines.

For the test of induction motors, use is made of the Heyland circle diagram, without which a text on alternating-current machinery at the present day would be considered incomplete. The stroboscopic method of Bernischke is mentioned and a few remarks by Hospitalier concerning the method are included. The discussion on the test of transformers is quite brief and is of interest chiefly on account of the Sumpner and Kapp opposition methods, which are outlined, and by reason of the diagram representing the testing circuits for three-phase transformers, which is clearly drawn, but scarcely more than referred to in the text. A considerable portion of the book is devoted to the tests of prime-movers, including steam, gas and hydraulic motors. The report of the Standardization Committee of the American Institute of Electrical Engineers on generators, motors and transformers as modified June, 1902, is given in full. Suggestions for convenient blanks for recording the data for various tests add to the value of the book. The text is characterized by a consistent attempt to exclude all unnecessary material, and that which is presented represents standard commercial practice.

New York Central Buying Trolleys.

This week Mr. Carstensen, fourth vice-president of the New York Central Railroad, gave out the following statement on the subject of the electrifying of a section of the West Shore Railroad. "The Cleveland (Ohio) interests controlling the Utica, Rome & Oneida Street Railways have acquired a controlling interest in the Syracuse Rapid Transit Company and propose to merge these properties into one system. The New York Central & Hudson River Railroad Company has purchased an interest in these properties and will probably enter into a trackage agreement for the use of the West Shore Railroad to connect these systems of which Syracuse and Utica are the centers. Further extensions east and west are in contemplation. The New York Central intends to aid the new company in taking care of and developing the short haul traffic to the fullest extent." It is twenty-six miles from Oneida to Syracuse.

Advices from Syracuse say that it is understood there in connection with the purchase of the Syracuse Rapid Transit and the Utica & Mohawk Valley trolley lines by H. E. Andrews, of Cleveland, Ohio, that he will organize a corporation to hold and unite the various properties. The New York Central or men interested in its management, it is said, furnished the greater part of the money for the purchase and will control the company to be formed. Syracusans interested in trolley roads say that the West Shore will be electrified from Canastota to Syracuse, permitting the Utica & Mohawk Valley to enter this city over that line.

New Westinghouse Railway Motor.

The Westinghouse Electric & Manufacturing Company has brought out a new railway motor, known as No. 101, to supply the demand for a motor of about 40 hp nominal rating. Under usual conditions of operation, a double equipment of these motors is suitable for single-truck cars, weighing from 16,000 to 18,000 pounds, without equipment or load, and for double-truck cars of equal or slightly greater weight. A quadruple equipment will, under similar conditions, successfully operate a double-truck car weighing approximately 30,000 pounds, exclusive of equipment and load.

The motor has a nominal rating at 500 volts of 40 hp for one hour. The curves herewith indicate more exactly the performance characteristics of the motor under the given conditions of gearing, load and speed. It has a continuous capacity of 35 amp. at 300 volts, or 33 amp. at 400 volts. At the close of a shop run of twenty-four hours' duration, at either of these loads, the rise in temperature of the motor windings, as measured by thermometer, will not exceed 75° C. When operated under a running car, better ventilation is usually secured, and the rise in temperature should not exceed 55°

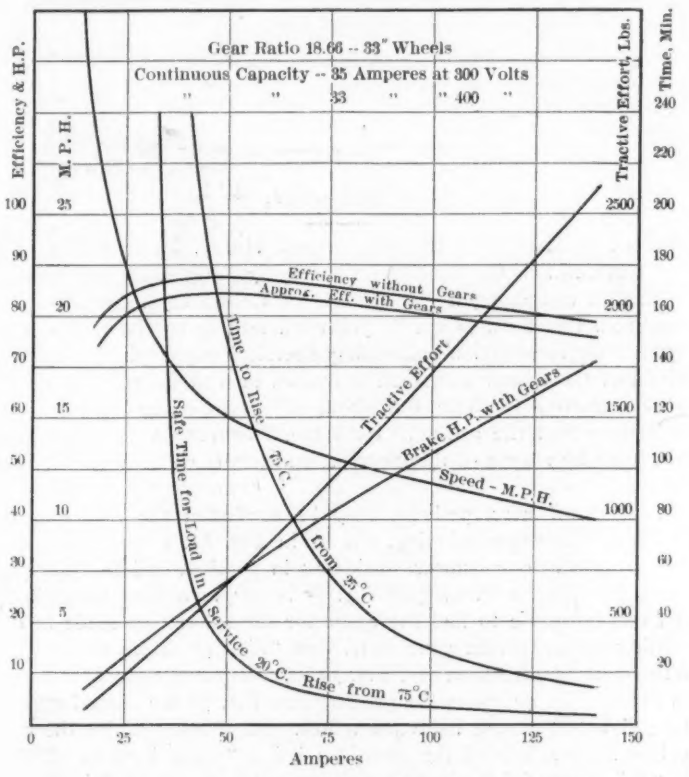

Gear Ratio 18.66 -- 33" Wheels
Continuous Capacity -- 35 Amperes at 300 Volts
" " 33 " " 400 "
Efficiency & H.P.
M. P. H.
Tractive Effort, Lbs.
Time, Min.
Efficiency without Gears
Approx. Eff. with Gears
Time to Rise
Tractive Effort
Brake H.P. with Gears
Speed - M.P.H.
75° C.
from 35° C.
Safe Time for Load in Service 20° C. Rise from 75° C.
Amperes

FIG. 1.—PERFORMANCE CHARACTERISTICS OF MOTOR.

C. Heavier loads may be safely carried for shorter periods, with corresponding higher temperature, as indicated by a time-temperature curve, based on a temperature rise in the interior of the motor coils of 20° C. above that of ordinary operation. If, for example, the motor has been running at a load of 35 amp. at 300 volts for such a time that a temperature of 75° has been reached, it may then be operated for 1½ hours at a load requiring 37½ amp., or for one-half hour at a load of 50 amp., with an increased rise in temperature not exceeding 20° C. These temperatures are well within safe

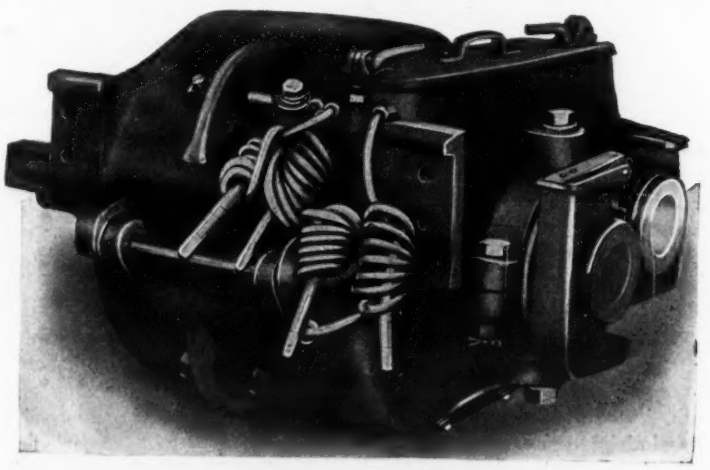


FIG. 2.—GENERAL VIEW OF MOTOR.

limits, and do not subject the insulation to injury or rapid deterioration.

The motor coils are wound with copper strap, insulated with asbestos and mica, and protected by heavy wrappings of tape. Flat steel springs between the coils and frame prevent looseness due to shrinkage. Protection against mechanical injury is provided by leatheroid washers and oiled duck.

The armature core is made up of circular punchings of soft steel,

built up on a cast-iron spider, and secured between end plates of cast iron. The armature coils are imbedded in rectangular slots in the core, and held in place by retaining wedges of hard fibre. The complete armature is 14 in. in diameter. Wiper rings are pressed on the shaft outside the armature to prevent the introduction of oil within the motor frame.

The commutator is formed of 111 hard-drawn copper bars, built up together upon a cast-steel bushing and pressed on and keyed to the armature spider. The commutator face is 10 in. in diameter by 4 1/16 in. in width, and presents a wearing depth of approximately ¾ in.

The brush holders are independently supported from the upper frame and are of the sliding type, with shunts. Each arm carries

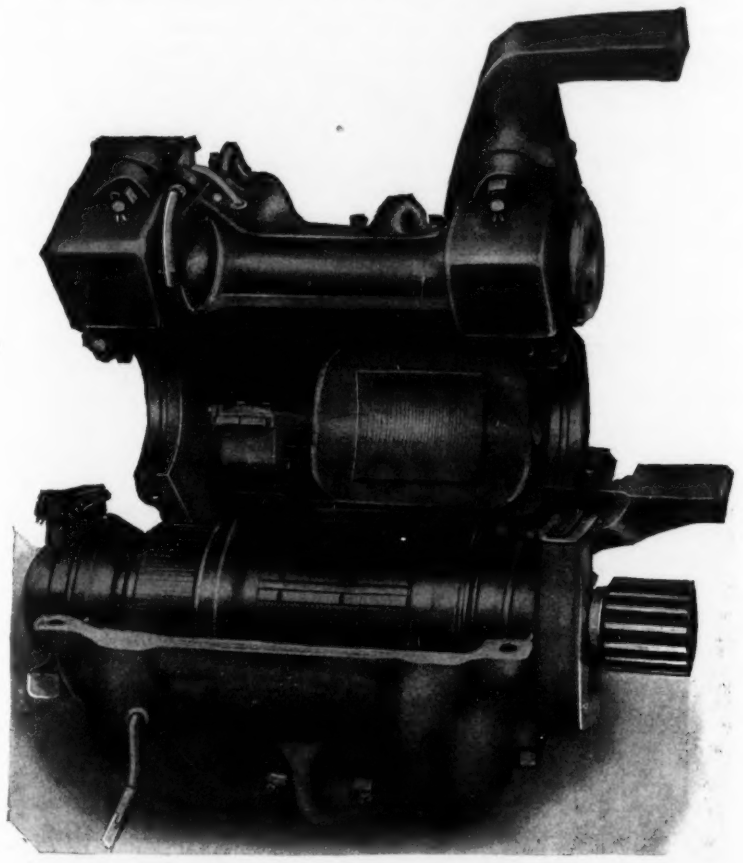


FIG. 3.—MOTOR OPEN.

two special brush springs of flat phosphor-bronze. The shunts lie between the pressure fingers and the arm. The brushes, two per arm, are each ½ in. by 1¾ in. in section.

The gear is made of cast steel in two parts, which are bolted together and keyed to the axle. The face is 5 in. wide. Gear ratios of 15:69 to 26:58 may be used; 15:69, 18:66 and 22:62 are standard. The gears may run in oil.

The weights of the No. 101 motor are approximately as follows: Motor alone, 2,315 pounds; motor complete with gears and gear case, 2,645 pounds; armature complete with commutator and shaft, 593 pounds. A complete double equipment, including two motors, two controllers and the usual details will weigh, approximately, 6,430 pounds. A corresponding equipment of four motors, two controllers, etc., will weigh, approximately, 12,160 pounds.

Electrically-Driven Rock Drill.

The accompanying illustration shows an electrically-driven, all-steel rock drill manufactured by the Gardner Electric Drill & Machinery Company, Cleveland, Ohio, some of the features of which are simplicity of mechanism, few parts, accessibility and ease of taking up all wear, since every bearing is adjustable.

The drill is actuated by a loose rod running through the gear case and motor, and this imparts motion through a pair of bevel gears and crank shaft to the drawbar and piston, the latter being cushioned with gangs of helical springs which absorb the shock of the blow. The energy thus stored up on the back stroke is utilized in forcing the steel into the rock on the forward stroke. The motor, it will be seen, is spherical in form and entirely enclosed, the armature shaft extending to the bevel gearing at the head of the gear case.

The drill strikes from 575 to 600 blows per minute, and, it is stated,

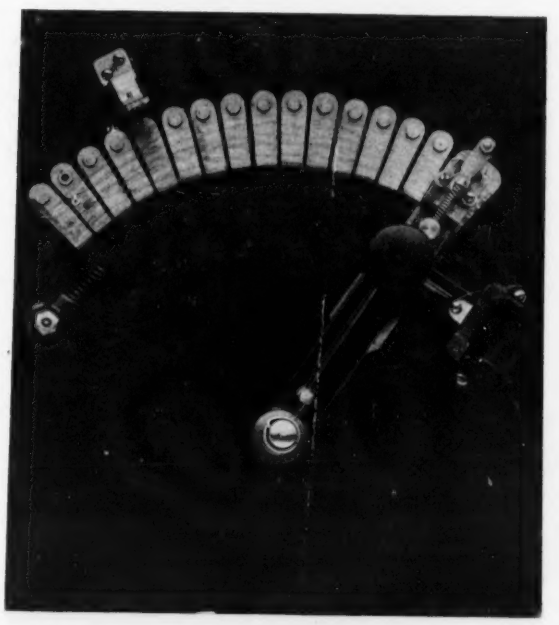
ELECTRICALLY-DRIVEN DRILL.

will cut as many feet per hour as any air drill, with at least one fifth of the power. Cutting speed, initial cost and cost of operation and maintenance are stated to be points in favor of the drill.

Motor-Starter.

The accompanying cut shows the face plate of the Ward Leonard Electric Company's motor-starter, for which the following distinctive features are claimed:

A quick-make and quick-break device, which lessens the possibility of drawing an arc upon the first live contact when starting or



MOTOR-STARTER.

stopping the motor. A magnetic blow-out, which, together with the quick-break device, prevents arcing. Self-aligning, removable contact shoes upon the starting lever arm, insuring perfect contact. Renewable contact segments. The Ward Leonard Electric Company claims that this type of face place is the most perfect and complete that has ever been placed upon the market.

Motor-Driven Tools at the World's Fair, St. Louis.

It has been the tendency to consider the advantages of motor drive merely from a point of efficiency of transmission by comparing this method with the ordinary form of shaft and belting. While this phase of the subject shows up very favorably, it has dropped into insignificance when compared with the other factors, including not only immediate convenience to the operator, greater outputs, ease of the arrangement of the tools, facility in extension of plant, saving in floor space, cost of maintenance and everything which conduces to the better utilization of the work of the employees. In the manufacture of any article it is the total cost of production that is of vital importance and which determines the selection of the equipment. In almost all establishments the labor cost is greater than both the cost of power generation and of transmission, so that any expedient by which the labor cost may be appreciably reduced is justifiable, even though it should increase the cost of power.

The introduction of electricity in manufacturing plants has been gradual, beginning with electric lighting, followed by the employment of the current for operating machines for which the ordinary methods were difficult of use, such as traveling cranes. The great convenience of these applications and the existence of a supply of current in the shop led to its continual extension wherever small amounts of power were wanted, a single motor being used to drive a countershaft for several tools. The so-called "group" system afterward was replaced to a great extent by the individual motor.

In considering the element of power application from a standpoint of efficiency of transmission, it is freely admitted that transmission by shafting and belting, even when the line is well planned and accurately aligned, absorbs a large portion of the power generated by the engine, ranging from 30 per cent. to 50 per cent., according to circumstances, and even attaining to 75 per cent. of the total power in instances where the buildings are scattered and the distances excessive. The discovery of the magnitude of the transmission losses by the use of shafting and belting, led to a close study of motor application and, in many cases, a marked economy has been shown by the substitution of electricity for the older system of transmission.

For all mechanically-driven shops, the friction load is a very large percentage of the average load. The loss of power from shafting is constant as long as the plant is running, whether one machine or one hundred machines be in operation, while the loss of electric transmission is a percentage of the actual power used at the tool. There have been some interesting tests made showing the relative efficiency of electrical transmission and mechanical transmission to the magnitude of the load, in which it is shown that with electrical drive the efficiency is about 68 per cent. at half load, compared with 30 per cent. for mechanical transmission, while at full load the electrical transmission reached 74 per cent. and frequently higher, while the mechanical drive attained only 60 per cent. From the foregoing it is evident that when the load is maintained at a maximum, a fair mechanical efficiency is possible, but this is seldom the case, due to the fluctuation in the demand for power in general shop practice.

In addition to the advantage of electric drive when considered from the point of efficiency in transmission, there are other factors of vastly more importance, when considered relative to the total cost of production. Thus, it is not uncommon for the output of a tool to be doubled, and, in some instances, trebled, by the use of individual motor drive. In addition to this is the convenience of arrangement, the advantage of the speed variation, all of which appeals to the works manager as the source of higher productive efficiency, in that its application to the various tools leads to more efficient results from the same amount of labor employed.

It is no longer a question as to the advisability of using motor drive in factories, but as to the best method of applying this form of transmission. Thus, for some factories the group system offers special advantages, while in others separate motors for every machine are desirable. To just what extent the individual method should be adopted is a subject much discussed at the present time, many claiming that the additional expenditure is not justified by the advantage gained; nevertheless, the individual equipment is gaining precedence. The method of drive to be selected should be largely determined by local conditions, depending on whether the machinery to be driven is an entirely new installation or whether it is an establishment changing over from belt transmission to electric. The portion of the day the various machines operate under load is also a determining factor. For instance, in applying electric transmission to a shop that has formerly been operated by shaft and belting, it may be that certain machinery, in given departments, that is used about the same portion of the day, can be driven from a short line shaft to advantage. Again, it may be that certain belted machines are sufficiently modern, so that one would not feel justified in junking them, and, by so grouping them that the friction load is small in comparison with the total load of the group, fairly efficient operation can be obtained.

The recent development of the high-speed steel has much to do with the promotion of the individually-equipped tool. Two years ago it was difficult to get any of the machine tool builders to consider a motor-driven equipment. At the present time, however, there are few of the leading tool builders who are not giving the matter serious consideration. The requirements that are being specified for the high-speed steel, namely, that in case of lathes they shall be capable of standing a ½-in. cut with ⅛-in. feed at 30 ft. per minute, while planers are required to stand a cut of ⅝ in. with ½-in. feed at 50 ft. per minute in mild steel, almost necessitates that they shall be provided with individual motors.

Factories that have adopted motor-equipped tools are quick to appreciate their merits as an efficient addition and, doubtless, many in the near future will profit by the experience of the Baldwin Locomotive Works, who claim that the introduction of electricity in their shops made a direct saving of 20 per cent. in their pay roll and 40 per cent. in the actual shop area. Among others, the Northern Electrical Manufacturing Company, of Madison, Wis., has made a careful study of motor application for machine shop purposes and has co-operated with a number of the leading machine tool builders with a view of designing a drive that will embody all of the desirable features for ready operation and quick change of speed, and, at the same time, keep the equipment free from complications which would be apt to puzzle a person not well versed in electrical matters. The Northern Electrical Manufacturing Company has also been able to obtain a variation in speed on the one-voltage system machines, which for a long time was considered impossible, having placed on the market a number of equipments with a range of speed of 2 to 1, 3 to 1, 4 to 1, and even 5 to 1 variation within the motor itself. With this range of speed in the motor itself and the use of the one-voltage system, the question of motor drive for machine tool purposes is reduced to a minimum of simplicity. Next in importance to getting a motor with appropriate speed variation is the arrangement of the controlling apparatus to enable the operator to secure the graduations of motor speed with least diversion of attention from the work. The illustration shows the arrangement of the motor and controller on a Lodge & Shipley engine lathe. A lever on the apron operates the motor controller through bevel gears, feathered rod, chain and sprocket. Thus the operator can adapt the speed of the lathe to its work without taking his eyes from the chip.

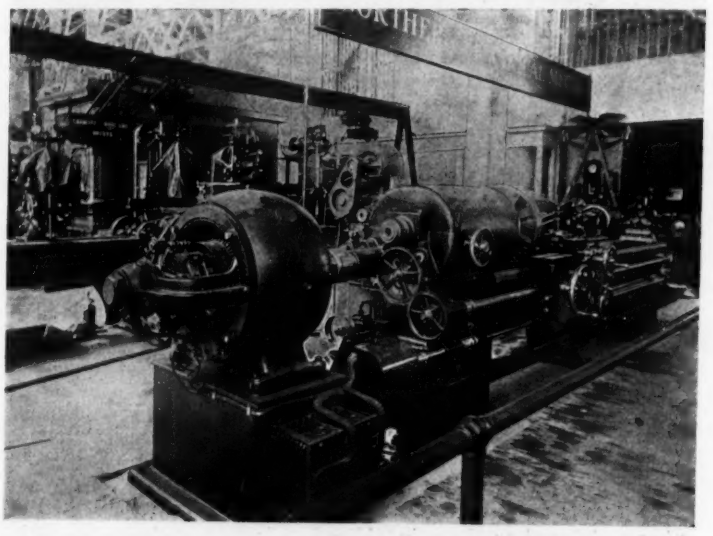


FIG. I.—NORTHERN MOTOR DIRECT-CONNECTED TO LATHE.

One of the most apparent and appropriate applications of electric motors direct to machine tools is that to grinders and buffing lathes. The speed of the motor and the high speed necessary for this kind

of work are coincident, so that the motor and tool form a harmonious unit. In fact, this has done much to widen the use of the emery wheel in many lines of machine shop and foundry work and has given it the place it deserves. With belts and pulleys little attention was given to speed, size of wheels, etc., but with the motor-driven grinder the whole tool can be carefully selected for the work, whether it be tool sharpening, grinding castings, etc. The Northern Electrical Manufacturing Company makes a line of emery grinders and buffing lathes which is complete and well designed. As may be noted from the illustration, the bearings and shaft are large, the base rigid, and the motor and bearings are protected from the dust. Bushings are provided to keep the emery from getting into the bearings. The speed can be varied to secure proper rate of cutting for varying diameters of wearing wheels. The starting and controlling

FIG. 2.—NORTHERN ELECTRICAL MFG. CO.'S MACHINE-TOOL EXHIBIT.

mechanism is located in the pedestal; the field rheostat for speed control is at the side, so that the operator can readily secure the speed best suited to the work at hand, a variation of 25 per cent. being possible. These machines come to the customers complete, except for the wheels, and need only to be connected to the power circuit. There are a number of motor tool equipments in the space of the Northern Electrical Manufacturing Company in Section 14 of

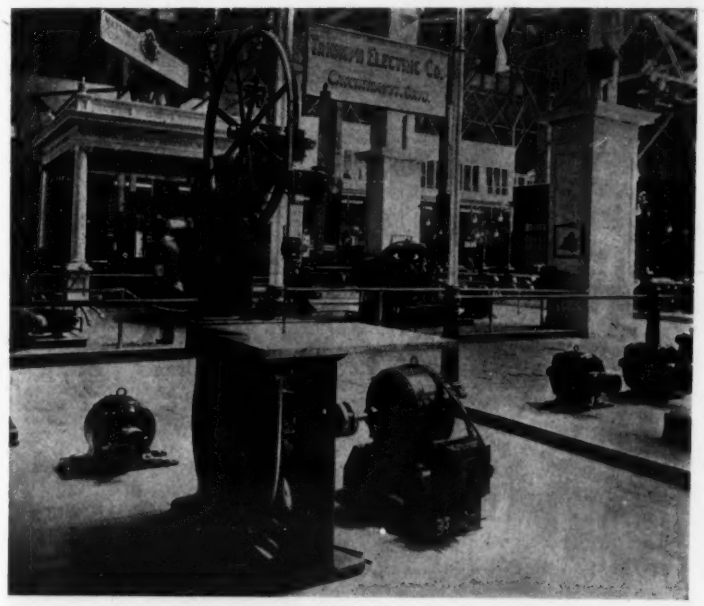


FIG. 3.—TRIUMPH MOTOR DIRECT-CONNECTED TO FAY & EGAN BAND SAW.

the Electrical Building at the St. Louis Exposition in charge of an expert, who shows the equipment in practical operation.

The advantage of motor-driven tools is nowhere more apparent than in the wood shop, because the work is generally intermittent and of comparatively short duration. With shafting this means a great and constant friction loss and a rapid deterioration on account of high speeds. Such tools require considerable power in starting and so the motor must be designed to withstand heavy temporary overloads without injury. A direct application of motor drive to a band saw is made by the Triumph Electric Company and exhibited in Section 8 of the Palace of Electricity. The motor is direct-connected to a Fay & Egan band saw, which is designed to run at one speed.

The distribution of electric power has become so widespread that even valves are now operated by motors. The illustration shows a Chapman valve with a General Electric motor for operating same.

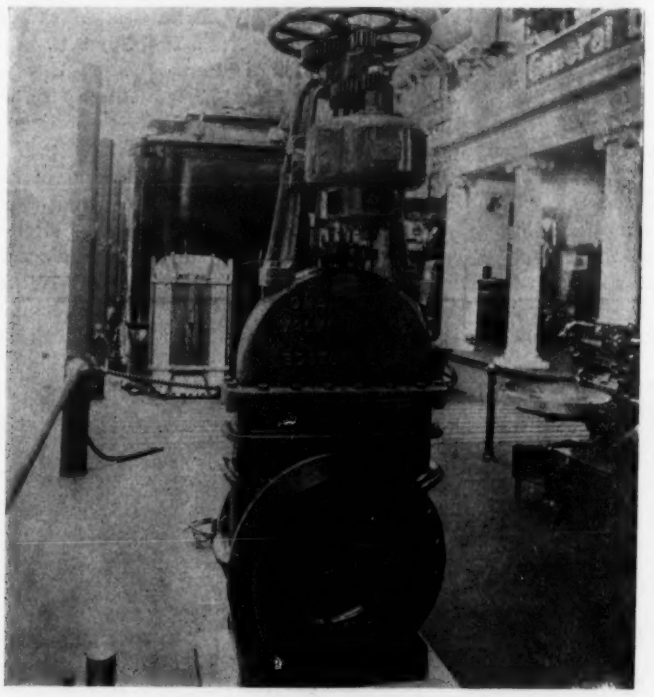


FIG. 4.—GENERAL ELECTRIC MOTOR GEARED TO CHAPMAN VALVE.

The motor is bolted direct to the yoke and connected to the valve spindle through spur gearing, the entire apparatus being self-contained and occupying but little more space than a plain valve. Electrically-operated valves are adapted for use in steam power plants in the exhaust steam piping or condenser systems, where it is necessary to open or close a number of valves simultaneously in the stopping or starting of engines, or in controlling the steam supply to engines for use in case of accident to the engine or throttle, or to

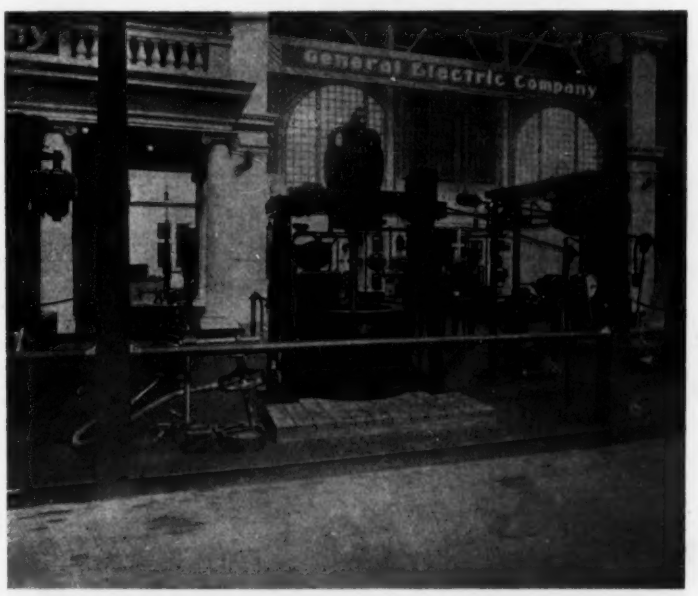


FIG. 5.—VARIED APPLICATIONS OF GENERAL ELECTRIC MOTORS.

cut out boilers or section of piping where it is not convenient to get at the valve itself, as these valves may be operated from a distant point. They are used in water power plants in operating head gates for controlling the flow of water through penstock to water wheel, and in water and sewage systems for control of valves where a number of valves have to be operated often or for control of water supply for fire protection, where additional pressure is desired at times, also in dry docks for the convenient operation of large gates

quickly and with expenditure of little labor. Direct or alternating current of any commercial voltage, phase or frequency can be used for power purposes and the switch with controlling apparatus may be placed at the valve or any convenient location for its operation. In the exhibit of the General Electric Company in the Palace of Electricity a 24-in. Chapman valve is shown with a 2-hp, 110-volt motor mounted upon same.

The Commercial Electric Company has adopted a variable-speed motor for machine tools, differing somewhat from others in the controller and double-commutator features. The illustration shows a 2-hp, variable-speed motor direct-connected to a 20-in. by 8-ft. engine lathe, built by the American Tool Works Company. In this particular case the speed variations are accomplished entirely by field control, but generally the motor is provided with a double commutator. In either event, the motors are designed to operate from any standard two-wire, single-voltage system. Speed variations of from four to one can be accomplished with practically constant horsepower and efficiency at all speeds, and constant speed at all loads with the controller set at a given point. The double-commutator motor has two windings, each of which is of the same size conductor. A speed controller is furnished for making the necessary combination of these armature windings and for varying the field strength

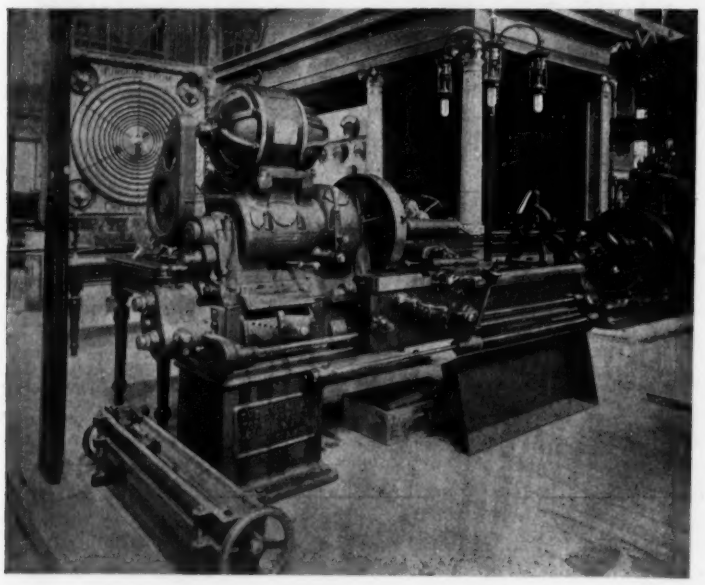


FIG. 6.—COMMERCIAL MOTOR DRIVING AMERICAN LATHE THROUGH FLEXIBLE CHAIN.

to secure intermediate steps between the armature combinations. These controllers are reversible, simple, compact and easy to place on any machine; and the changes are readily effected. Within the controller is a rotary starting and reversing switch, by means of which the motor is started, stopped and reversed while the speed control is set at any desired point. The speed controller and starting switch are combined into one piece of apparatus and enclosed so that it can be attached to any machine tool. Several points of advantage of such a system are as follows: It gives a range of speed of four to one in twelve uniformly graded steps without overlapping. The greatest torque is at slow speeds, so that pieces of large diameter may be turned with as heavy cuts as smaller ones. Speed is constant whether the tool is making a deep cut or running free. No power is wasted heating resistance coils. It can be installed on any standard two or three-wire, direct-current machine, nor is a special generator plant, motor-generator set or system of connections needed.

Another illustration represents the largest and smallest of the Willey motor-driven drills built by James Clarke, Jr., & Co. One is a radial drill and the other a small breast drill. The location of the driving motor on the head of the radial drill allows the power to be applied direct to the spindle without loss; it is simple and compact as can be made, and all parts needing attention are easily accessible for examination and adjustment. The motor frame is cast into the head of the machine and is directly geared to the spindle. It has a multipolar field, iron-clad armature, self-feeding carbon brushes and self-oiling bearings. It is made with two commutators in order to get a wide speed regulation with high efficiency on any speed. The motor has nine speeds, which, in connection with the back gears, give 18 spindle speeds, from 14 to 200 r.p.m. in geometrical progression. Motors are built to operate on single-voltage circuits, the speed changes are accomplished without armature resistance, and the motor runs at practically constant speed for any load in any position of controller. This feature of speed regulation on a single-voltage circuit is a very valuable one, as it enables this tool to be used in any shop having either the single or multiple-voltage distribution.

The Willey electrically-driven breast drill shown on the table of

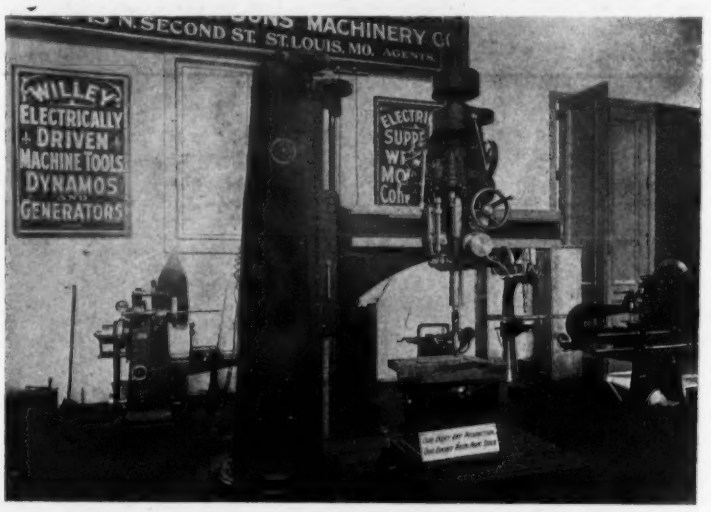


FIG. 7.—WILLEY MOTOR-DRIVEN DRILLS.

the radial drill was designed for drilling small holes and to replace hand and pneumatic tools. It is driven at a far greater speed than is possible by hand, besides allowing the operator to devote all his time and attention to guiding the drill, as the drill is instantly started or stopped by turning a thumbscrew at the side. These drills are built in two sizes and wound for 110 or 220 volts direct current. These tools are operating in Section 20, Electricity Building, with facilities at hand to show just what work can be done with them.

A small but useful motor-driven apparatus is an air pump with reservoir exhibited in the space of Roth Bros. & Co., in the Palace of Electricity. A ⅛-hp, 110-volt, direct-current motor is belted to the

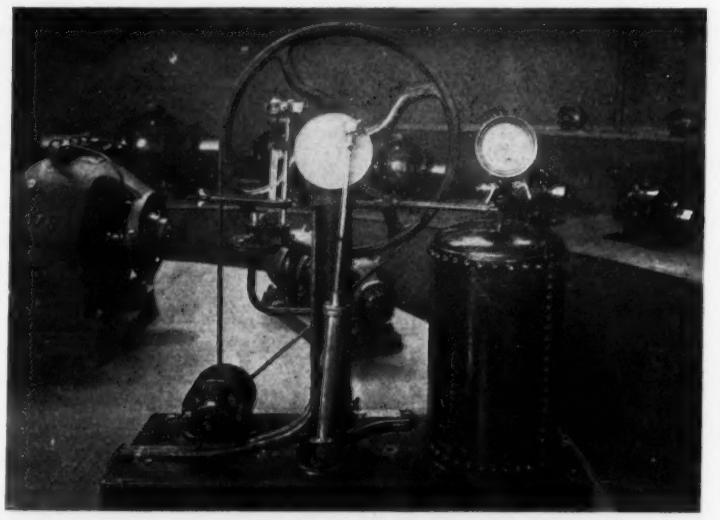


FIG. 8.—ROTH MOTOR-DRIVEN AIR PUMP.

large driving wheel of the pump. Attached to the air reservoir is a gauge and a diaphragm which automatically starts and stops the motor at certain predetermined pressures. This apparatus is very useful for dental and medical purposes. By allowing the air to exhaust slowly the operation of the apparatus is shown continuously.

The St. Louis World's Fair affords the opportunity for making a study of the use of electric motors to drive nearly every kind of tool made. Electrical manufacturers have gone into other fields and adapted their apparatus to every condition, whether it be driving a sewing machine or a printing press. But few modifications have been made to accommodate the motor and these reluctantly. It is, therefore, but right that while examining the multitude of motor-driven tools at St. Louis one should keep in mind that it has been the electrical industry which has constantly been in the van. The newest and most ingenious applications of motors are exhibited by the electrical manufacturers in the Palace of Electricity and without exception they are in full operation.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was some strength of tone in the speculative market, prices holding at moderate concessions from the advanced figures. The standard railroad stocks and the Steel issues led in the upward movement of prices. Various industrial specialties, including Amalgamated Copper, were strong on manipulation. Metropolitan Street Railway, after advancing on further reports of a deal with the subway company, was brought to a standstill by bearish talk regarding the property. There was more activity and improvement in Brooklyn Rapid Transit, though the manipulation was less vigorous. In the curb market more activity in outside securities was noted, and prices were generally higher. Interborough Rapid Transit did not attract the same amount of attention that it has commanded in the past few weeks. In summing up the week's business, the industrials, electrics and telegraphs show net gains, while the tractions suffered slight losses. Allis-Chalmers preferred closed at 45, a gain of 1 point; General Electric at 164, a gain of 5¼ points, and Westinghouse at 164½, a gain of 6½ points. The closing prices of the two last named stocks were also the highest quotations of the week, while the lowest for each was 157½. Brooklyn Rapid Transit lost ¼ point, closing at 50⅜, and Metropolitan Street Railway ¼, the last quotation being 116½. American Telephone & Telegraph made a gain of 1 point net, closing at 130, and Western Union was steady at 88. Following are the closing quotations of July 19:

NEW YORK

	July 12	July 19		July 12	July 19
Allis-Chalmers Co.	8¾	9	Electric Vehicle	9¼	9¼
Allis-Chalmers Co. pfd.	43¼	44¾	Electric Vehicle pfd.	13	13⅛
American Tel. & Cable.	89	88	General Electric	158¾	163¾
American Tel. & Tel.	128⅛	133	Hudson River Tel.	..	..
American Dist. Tel.	23	24	Metropolitan St. Ry.	115¾	117¾
Brooklyn Rapid Transit.	50⅛	52⅝	N. Y. & N. J. Tel.	..	147
Commercial Cable.	178	178	Marconi Tel.	..	..
Electric Boat.	41	40	Western Union Tel.	87	88
Electric Boat pfd.	74	70	Westinghouse com	157	162¾
Electric Lead Reduction.	¼	⅜	Westinghouse pfd	180	180

BOSTON

	July 12	July 19		July 12	July 19
American Tel. & Tel.	128⅛	132⅞	Western Tel. & Tel. pfd.	81	92
Cumberland Telephone.	113¾	113¼	Mexican Telephone.	*1⅛	1¼
Edison Elec. Illum.	249¼	248	New England Telephone.	121	124½
General Electric.	..	..	Mass. Elec. Ry.	19¾	*20
Western Tel. & Tel.	9⅛	12½	Mass. Elec. Ry. pfd.	73¾	*74

PHILADELPHIA.

	July 12	July 19		July 12	July 19
American Railways.	45¾	47⅛	Phila. Traction.	98	98⅝
Elec. Storage Battery.	57	60	Phila. Electric.	6	6⅛
Elec. Storage Battery pfd.	57	60	Phila. Rapid Trans.	11¾	13¾
Elec. Co. of America.	8	9⅛			

CHICAGO

	July 12	July 19		July 12	July 19
Central Union Tel.	..	..	National Carbon pfd.	101½	103
Chicago Edison.	144	142	Metropolitan Elev. com.	19¼	19⅛
Chicago City Ry.	168	175	Union Traction.	4	4¼
Chicago Tel. Co.	120	120	Union Traction pfd.	26	27
National Carbon.	28½	29½			

*Asked

RECEIVER FOR RICHMOND, VA., TROLLEYS.—The Virginia Passenger & Power Company, embracing the Richmond Passenger & Power Company and the Richmond Traction Company, was placed in the hands of receivers last week by Judge Waddill, of the United States District Court, upon petition of the Bowling Green Trust Company, of New York City. William Northrup and Henry T. Wickham were named as receivers. The Virginia Passenger & Power Company is capitalized at $15,000,000 and operates in three Virginia cities, Richmond, Manchester and Petersburg. Frank Jay Gould is the majority stockholder. A suit brought by George E. Fisher, of New York, for a receivership is now being argued in the State Circuit Court at Petersburg, the defendants claiming that there is no necessity for a receivership. The explanation of the application to a United States Court for the appointment of a receiver in the case of the street car properties, is that it was made by the Gould interests to prevent, as they claim, the disintegration of properties. The receivers appointed have accepted and qualified. The order for receivership was signed by Judge Waddill, at Norfolk, at 3 o'clock in the morning, the attorney for the Gould interests having proceeded to that city by a special train to Newport News, and thence by tug to Norfolk. This was done, it is said, to head off Fisher, who, is was understood, intended to apply to the United States courts for a receiver.

SCHENECTADY RAILWAY SALE.—It is stated that negotiations are going on for the purchase by the Delaware & Hudson or by the Delaware & Hudson and New York Central roads jointly, of the Schenectady Railway Company, which operates a system of street railways between Schenectady, Albany and Troy, N. Y., and is owned by the General Electric Company. The Schenectady Railway Company was originally built by the General Electric Company. The General Electric people sold $2,000,000 of its bonds and extended the road to Albany, Troy and Ballston Spa and for the past two years it has been earning about 16 per cent. upon its capital of $600,000. The road owns the Schenectady Illuminating Company and controls the light, heat, power and traction facilities of the growing city of Schenectady. Its interurban line is one of the best built lines in the country and has been gradually developing until it is a decided factor in the local passenger business between Schenectady, Albany and Troy, controlling about 35 miles of road. Last year the capital of the company was increased from $600,000 to $7,000,000 and at the time it was stated that there was some trade in prospect which would warrant this increase in the capital. The road is now earning between 4 and 5 per cent. upon $7,000,000 capital.

DIVIDENDS.—The India Rubber & Gutta Percha Insulating Company, of Yonkers, N. Y., has declared a dividend of 2½ per cent. on the capital stock, payable July 11. The company continues to do a large business in Habirshaw wires and cables. The Electric Company of America directors have declared the regular semi-annual dividend of 3 per cent. The dividend is payable July 30. The Monongahela Street Railway, of Pittsburg, has declared an initial dividend of 2 per cent.

Commercial Intelligence.

THE WEEK IN TRADE.—More definite news regarding the condition of crops is eagerly awaited, and until then little improvement is looked for in distributive trade and industry. Good progress has been made by corn, spring wheat and cotton, and this has overshadowed disappointing returns from the winter wheat crop. Railway gross earnings for the fiscal year will, *Bradstreet's* says, show an increase over the best previous years, but net results are less clearly defined, with the question whether an increase or a decrease will be shown still in doubt. The general undertone is one of confidence, good results being looked for by the business world from an expected large volume of fall trade. Regarding the situation geographically, the South has the best outlook, the crop conditions in that section being satisfactory. Distributive markets have been under the influence of seasonable conditions, and general quietness prevails. Collections are slow. There is increased quiet in the iron trade, production being scaled down to meet actual consumption. The output of pig iron for the past six months is estimated at about 8,000,000 tons, a reduction of 15 per cent. from the same period of 1903. Finished products are quiet. Copper was very active and the market displayed considerable strength. Home consumers bought freely, and the European demand continues satisfactory. The closing quotations are: 12½ to 12⅝c. for Lake; 12⅜ to 12½c. for electrolytic; 12⅛ to 12¾c. for cathodes and casting stock. Business failures for the week ending July 14 aggregated, according to *Bradstreet's*, 203, against 172 the week previous and 173 the corresponding week last year.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has recently closed contracts for installations of "Chloride" accumulators for the following railways: With Westinghouse, Church, Kerr & Co., engineers for the Long Island Railroad Company, Hamil, L. I.; Portsmouth, Dover & York Street Railway. Dover, N. H.; California Gas & Electric Corporation for the Petaluma & Santa Rosa Electric Railway of California; Toledo Railways & Light Company, Toledo, Ohio, and the City Railway Company, Dayton, Ohio. Contracts have also been closed for lighting and power service with the Mutual Life Insurance Company, New York City; Central Oil & Gas Stove Company, Gardner, Mass., and residential plants for Mrs. A. N. Kendle, Lamoile, Ill., and Mrs. C. E. Bates, Dalton, Mass. Westinghouse, Church, Kerr & Co. have ordered over 2,000 cells of "Chloride" accumulators for use in train lighting on the New York, New Haven & Hartford Railroad, and over 600 cells have been ordered for the Atchison, Topeka & Santa Fe Railroad Company, for signal service. Increases have been made in the plants of the Lancaster Traction Company, Lancaster, Ohio, the Denver & Champaign Rail-

way Company, St. Joseph, Ill., the Danville Street Railway & Light Company, Georgetown, Ill., and Rochester Railway & Light Company, Rochester, N. Y.

G. M. GEST, the expert subway contractor, has been awarded the complete installation of an underground conduit system, including all the electrical distribution to service and house connections, for the South Bend Electric Company, South Bend, Ind. This work covers all of the main streets of that city and will be one of the most complete and modern conduit systems so far constructed. Work is to be completed at the earliest possible moment, and a large force of men will be employed on same. The Oliver Chilled Plow Works, who own their private plant at the same place, have contracted with the same contractor for the construction of their underground conduit system. While not as great a system as the other, it will feed some of the most important parts of the city. Mr. Gest has also been awarded a contract by the Toronto Railway Company, Canada, for the construction of its entire subway system, covering the main thoroughfares of the city of Toronto. Work is to be begun at once, and a large force of men is to be employed. This is part and parcel of the many improvements inaugurated in the reconstruction of the electrical equipment of this railway, which is being changed in all respects to make it absolutely modern and up-to-date.

HARRISBURG ENGINE CONTRACTS.—Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York, have a contract for an additional unit to be put in the Equitable Life Assurance Building, at Denver. There will be a 60-hp Harrisburg standard engine direct connected to a Westinghouse generator. The Hotchkiss School, Lakeville, Conn., is to have a 125-hp Harrisburg standard engine arranged for double direct connection to two 35-kw General Electric generators. This equipment is for lighting. The Robinson & Horman Brewing Company, Staten Island, has contracted for a 75-hp Harrisburg center-crank engine for direct connection to a Westinghouse generator for both light and power. The Harlem River Amusement Company, One Hundred and Twenty-seventh Street and Second Avenue, has ordered a 150-hp Harrisburg standard engine for direct connection to a Bullock generator for lighting purposes. Mackenzie, Quarrier & Ferguson have secured the contract for the complete electrical installation of the Sixty-fifth Street Public Baths. There will be two 50-hp Harrisburg standard engines, direct connected to 30-kw generators which have not yet been ordered.

A NEW CONDENSER COMPANY.—The International Condenser Company was incorporated at Trenton, N. J., last week, with a capital of $5,000,000. Among the incorporators are Homer E. Hoadley, of Chicago, and R. G. McDonald, one of the officers of the Manhattan Transit Company, doing business at 250 East Forty-eighth Street. About a month ago there was incorporated under the laws of the State of Maine the American Oil Engine and Shipbuilding Company, with a capital about the same as that of the International Condenser Company. Among the incorporators of the Maine corporation were William M. Hoagland, the general manager of the Manhattan Transit Company, and W. T. Hatch, of Stamford, Conn. The Manhattan Transit Company is one of the properties controlled by Joseph H. Hoadley. It controls the rights and franchises of the General Carriage Company, which secured a franchise from the New York Legislature several years ago to run electric and horse-drawn vehicles on any street or avenue within the State of New York.

SOME CROCKER-WHEELER ORDERS.—Mr. F. B. De Gress, manager of the New York offices of the Crocker-Wheeler Company, reports receipt of numerous orders for small motors varying in capacity from ½ hp to 1 hp, for driving small pumps in and around New York City for household use. Among other orders recently obtained is one for two 50-kw engine type generators to be used for lighting the Groton (Conn.) school. The generators will be direct-connected to Harrisburg engines of 75-hp capacity each. The Geo. F. Troutwine Company, glove manufacturer, of Gloversville, N. Y., has ordered a 22½-kw belted generator and several small motors. The Construction Realty Company, of 112 West Fortieth Street, has contracted for two 25-kw engine type generating units for lighting the Grand Hotel extension. Eleven small motors have been ordered by the Jersey City Printing Company, where upward of 60 machines are already in operation.

EXPORT TRADE FOR 1903-1904.—The figures for June are now obtainable so as to complete the exports and imports for the year. June was a very slack export month, but even then the general results are very satisfactory. The merchandise imports were $81,014,973, or nearly $900,000 less than in 1903, and the merchandise exports were $93,197,134 or nearly $2,000,000 less than in 1903; but the net shows an excess of exports of $12,182,161. For the year the imports were $990,512,617 and the exports $1,460,713,854, or an excess of exports of $470,201,237, being nearly $80,000,000 more than last year, and nearly as much as in the year 1902, although very much below the great year 1901, with an excess of $664,000,000. Apparently the excess of exports is growing again. It is a comfortable margin as it stands.

AUTOMOBILE ENGINE BUILDERS.—The Executive Board of the recently organized National Association of Engine and Boat Manufacturers met last week at the Hotel Manhattan, New York City, and elected officers for the organization. The officers elected were as follows: President, John J. Amory, of the Gas Engine & Power Company; first vice-president, H. A. Lozier, of the Lozier Motor Company; second vice-president, J. M. Schoonmaker, of the Charles A. Strellinger Company; third vice-president, H. R. Sutphen, of the Electric Launch Company; treasurer, J. S. Bunting, of the Smith-Mabley Company; secretary, J. Gambel.

A WIRELESS CONTRACT.—A dispatch from Washington, D. C., of July 13 says that General Greely, the Chief Signal Officer of the Army, has entered into an agreement with the National Electric Signal Company by which the company is to establish a wireless telegraph system between Forts Wright and Schuyler, N. Y. The distance between these posts is 97 miles. According to the terms of the agreement the Government will buy the system on condition that it proves satisfactory, but assumes no obligation in the event of failure or unsatisfactory service.

THE BURKE ELECTRIC COMPANY has just been incorporated in New Jersey with a capital stock of $150,000. The incorporators are James Burke, Francis E. Drake and Paul Wilcox. The object of the company is to manufacture the Burke dynamos and motors, which are widely known in Europe, where they have been built for some years by Mr. S. Bergmann, from the designs of Mr. Burke, a well-known American engineer now in this country again.

LINK-BELT MACHINERY FACTORY.—Dodge & Day, Philadelphia, have just completed the installation of a 340-hp Buckeye vertical, cross-compound engine, direct connected to two G. E. 100-kw, direct-current, compound-wound generators for the Link-Belt Engineering Company, Nicetown, Pa. The same concern is at work on a three-motor, electrically operated locomotive crane for this company, to handle beams, angle irons and other heavy structural material for use in its new storage yard.

SEPARATE LIGHTING PLANT FOR HIPPODROME.—The new Hippodrome which is to be built by the George A. Fuller Company, at Sixth Avenue, between Forty-third and Forty-fourth Streets, for Thompson & Dundy, of Luna Park fame, is to have a good-sized electrical plant. The electrical department of the Fuller people is in the Flatiron Building. Mr. James H. Morgan, 949 Broadway, is the architect engaged for the new building.

MANUFACTURE OF INSULATORS.—Mr. E. W. Lathrop, of 516 Atlantic Avenue, Boston, Mass., informs us that it is understood that a $100,000 company is being formed by Boston and Rochester parties to manufacture a high grade of porcelain insulators. A site has been secured at Lima, N. Y., near the natural gas fields, and it is understood that building operations will be begun immediately.

AN INTERBOROUGH CONTRACT.—The Manhattan Elevated system of the Interborough Rapid Transit Company has closed a large contract with the D. & W. Fuse Company, of Providence, R. I., for cutouts and fuses for its heavy service. The order has been delivered and the company is using four fuse boxes on each car. The tests were of a most severe character before the order was placed.

AFTER MEXICAN CONCESSION.—The Mexican authorities have been approached by Manuel Pardo, a Mexico City engineer, who is understood to be acting for American interests, for a concession to build a plant along the River San Miguel in the district of Zacatlan, State of Puebla. Current is to be generated for lighting and general power purposes in that locality.

CRANE EQUIPMENT FOR CHRISTCHURCH, NEW ZEALAND.—The Cleveland (Ohio) Car & Crane Company secured the contract for the crane equipment to be put in the power house for the Christchurch (New Zealand) municipal electric traction system. The bulk of the other equipment will also be manufactured in the United States.

BIG EQUIPMENT FOR NEW UPTOWN HOTEL.—A $2,500,000 hotel is to be built between Seventy-eighth and Seventy- ninth Streets, between Broadway and West End Avenue, by Mr. William Waldorf Astor. Clinton & Russell have been retained as architects. A big electric lighting plant will be installed.

EQUIPMENT FOR NEW WEST POINT BUILDINGS.—Plans are being drawn up by Mr. Henry C. Meyer, Jr., of 1 Madison Avenue, New York City, for the electrical equipment to be installed for lighting the extensive new buildings at West Point.

General News.

THE TELEPHONE.

ATLANTA, GA.—The Bell Telephone Company has been granted a franchise here.

BELAIR, ILL.—The Louis Belair Telephone Company has been incorporated with a capital stock of $5000. Among the directors are L. M. Biggs and J. C. Farley.

SHELBYVILLE, ILL.—The Rose Township Mutual Telephone Company has been incorporated with a capital stock of $1020. The directors are P. Roessler, Geo. Ruff and others.

TAYLORVILLE, ILL.—The Taylorville Home Telephone & Telegraph Company has been incorporated with a capital stock of $75,000. The directors are G. E. Waldo, C. E. Smith and others.

CHICAGO, ILL.—Assistant Chief of Police Schuettler has taken out two private telephone switchboards upon the discovery of evidence of the use of these exchanges for gambling purposes. An injunction issued by Judge Brentano to one James Harding about a month ago restrained the telephone company from taking out the telephones, but the police say that Harding is a fictitious person, thus nullifying the injunction.

WILMOT, IND.—The Wilmot Mutual Telephone Company has been incorporated with a capital stock of $10,000.

FRANKLIN, IND.—The Franklin Telephone Company has increased its capital stock in the sum of $5000 with a view of making improvements and installing modern equipment.

DARLINGTON, IND.—The Darlington Telephone Company has increased its capital stock from $1000 to $10,000 for the purpose of extending the plant and installing new and up-to-date equipment. Daniel Lewis is president and James A. Peterson is secretary.

FRANKTON, IND.—The Farmers' and Citizens' Telephone Company has filed articles of incorporation with a capital stock of $10,000. The purpose of the company is to establish an exchange in Frankton and telephone lines throughout Madison County and surrounding counties. Thos. Bromley, Jr., E. H. Phillips and George F. Quick are the incorporators.

WINTERSET, IA.—The Hawkeye Telephone Company will erect a new central exchange here.

MOULTON, IA.—The local telephone exchange has been sold to C. A. Mann and improvements will be made.

ADAIR, IA.—The Grand & Audubon Township Mutual Telephone Company has been incorporated with $3000 capital stock.

FRANKFORT, KY.—The Big Leather Wood Telephone Company, of Perry, has been incorporated. The capital is $2500.

WHITE PLAINS, KY.—The White Plains & Red Hill Telephone Company has been incorporated with a capital stock of $5000. The directors are B. F. Dukes, R. T. Gunn and others.

WINNIPEG, MAN.—It is the intention of the Bell Telephone Company to erect a large addition to its present building and to install a switchboard with a capacity for 10,000 subscribers, before the end of the present year.

HOMER, MICH.—The Homer Telephone Company is contemplating an extension of its plant. Mr. R. C. Smith is president and manager.

HANCOCK, MICH.—The Michigan State Telephone Company will make improvements to its system in the copper country, to cost $75,000.

ALEXANDRIA, MINN.—J. B. Cowing and G. G. S. Campbell were granted a franchise for a local telephone exchange.

CLARKFIELD, MINN.—The Clarkfield Telephone Company has been incorporated; capital, $3000. The directors are John Larson, W. B. Torgerson, A. J. Johnson, E. Monson, J. H. Lynner, J. N. Silver and George J. Piersol.

LAKE VALLEY, MINN.—The Lake Valley Co-operative Local Telephone Company has been incorporated; capital, $10,000. Incorporators: John A. Norsen, E. M. Blomquist, T. Heggen, Lars Peterson, Lake Valley; P. Johnson, Clifton.

HASTINGS, NEB.—The city council has unanimously voted to grant a franchise to the Hastings Independent Telephone Company. The rates agreed upon are $1.50 per month for residences and $2.50 per month for business houses until the new system shall have 600 subscribers, then an additional toll of 10 cents per month per telephone will be charged. Wires in the business portion of the town will be underground.

BUFFALO, N. Y.—The Haines Telephone Company has sold its local plant, also the one located at East Aurora, to the Inter-Ocean Telephone Company. A new system will be installed here and greatly improved at once.

NORTH COLLINS, N. Y.—The North Collins Telephone Company, which was recently incorporated, expects to start business in the course of a month. Its switchboard will have a capacity of 100 drops, North Electric apparatus being used. It will start with 150 subscribers, and expects to build lines to adjacent villages.

ELMIRA, N. Y.—It is reported that three judgments aggregating some $5100, have been entered at the Erie County court house against the Albion Independent Telephone Company, at Albion, Pa., all being subject to immediate foreclosure. This company has over 150 subscribers, but is operating at rates wholly insufficient to even pay expenses.

UTICA, N. Y.—A number of extensions and improvements are about to be made by the Utica Home Telephone Company, among them the laying of 8000 feet of underground cable. The company is equipping its switchboard so as to accommodate 800 additional subscribers. The Rome Independent Telephone Company is also getting ready to make several improvements. Two new sections to the switchboard will be made and 20,000 feet of aerial cable will be strung.

SALISBURY, N. C.—A movement is on foot to organize a new telephone company at Salisbury to compete with the Bell Telephone Company.

PERRY, OHIO.—A new company has been formed at Perry to succeed to the Madison Telephone Company's business. It is the intention of the new company to extend the service.

CLEVELAND, OHIO.—A short time ago Frederick S. Dickson, president of the Cuyahoga Telephone Company, sent out a list of invitations to the stockholders of the Cuyahoga Telephone Company and patrons, asking them to visit the exchange on the top floor of the Electric building, and inspect the manner and method of doing business. The reception was held two days recently. The Cuyahoga Telephone Company has just put in an entirely new outfit.

CLEVELAND, OHIO.—Work has been started upon the construction of extensive additions to the lines of the United States Telephone Company. The connection between the United States Company and the new independent long distance company of Indiana at Richmond, Ind., is being made and many other lines are being put up. It is the intention of the company to spend at least $200,000 this summer and to continue the work as fast thereafter as possible.

FREDERICK, OKLA.—The Southern Oklahoma Farmers' Telephone Company has been incorporated with a capital stock of $2000. The directors are C. A. Smith and J. O. West.

READING, PA.—The Consolidated Telephone Company will build a line to Lebanon and another through the Conestoga Valley. At Birdsboro connection will be made with a line being built from Lancaster, taking in all of the towns in southern Berks County.

COLUMBIA, S. C.—The Southern Bell Telephone Company is preparing to reconstruct the exchanges recently bought at Cheraw, Dillon, Marion and Mullins, S. C. The long distance service, it is said, will also be improved through the Pee Dee section, giving extensive connections from Columbia.

FAIRFAX, S. D.—The St. Elmo Townsite Company has been formed to establish the new town of St. Elmo in this county. The promoters state the town will have electric lights and telephones in the shortest time ever made by a new town.

SALT LAKE CITY, UTAH.—It is announced that the Postal Telegraph Company will be operating in this city by the end of September of this year. This has been made possible through a contract between the Postal Company and Rocky Mountain Bell Telephone Company, by the terms of which the former is privileged to use the Bell Company's poles from Cheyenne to Laramie, Wyo., and from Fort Steele, Wyo., to this city and from here to Butte.

ASHLAND, WIS.—The Ashland Telephone Company contemplates erecting a building for its own use, and extending its lines a distance of 60 miles.

CHIPPEWA FALLS, WIS.—A new rural telephone company has been organized here, to be called the Melville Settlement Telephone Company. J. W. Melville is president.

ELECTRIC LIGHT AND POWER.

EAST LAKE, ALA.—The Birmingham Railway Light & Power Company, of Birmingham, has secured a franchise to install an electric light system in East Lake.

JASPER, ALA.—The Jasper Water, Light & Power Company has been incorporated with a capital of $50,000, with $30,000 paid in, by J. M. Cranford, D. K. Carter and others.

NORTH LITTLE ROCK, ARK.—The property owners have petitioned the Council to construct water works and an electric light plant.

LOS ANGELES, CAL.—On July 1 this city was electrically connected by the completion of the cables of the Kern River Light & Power Company over which 10,000 horse-power is brought to this city from a source over 100 miles away.

EUREKA, CAL.—The Humboldt County Water & Power Company has been incorporated by B. von Homeyer, Congressman Gillett, N. H. Hine, and others. The plan covers a power plant in Eureka and a diversion of water from Mad River; a reservoir will be built between the point of diversion and Eureka, and at that point a vast amount of power will also be developed, so that the city plant will be used only as an auxiliary one.

RED BLUFF, CAL.—E. B. Walbridge and others are reported interested in a new power project for this section. The new company is called the Tehama Power & Transportation Company. It proposes to take water from Mill Creek, near Morgan Springs, near Mt. Lassen, and convey it by ditches and flumes to a place east of Red Bluff and Tehama.

RICHMOND, CAL.—The arc lamp service in this town is paid for by public subscription, as the town has not yet been incorporated. The rate is $75 per year per lamp on the basis of a 1 o'clock every-night schedule. The Richmond Light & Power Company supplies the service, its system being connected to the lines of the Bay Counties Power Company. The connecting links consist of three 100-kw and three 50-kw 50,000/2200-volt General Electric transformers. Mr. C. W. Waller, San Francisco, is secretary of the company.

NORFOLK, CONN.—At a meeting of the stockholders of the Norfolk Electric Light & Power Company the reorganization of the company was completed and the reconstruction of the plant will be begun at once.

DAHLONEGA, GA.—The new $75,000 dam of the Crown Mountain Mining & Milling Company near Dahlonega has been completed. This plant will be operated by electric power, and the town may be lighted from the same source.

WASHINGTON, D. C.—It is stated that $575,906 is now available for the improvement of the Washington Navy Yard, and under the direction of Capt. J. M. Bowler, head of the Department of Yards and Docks, work will begin immediately on the extension of improvements planned for the 14 acres of ground recently acquired west of the old yard. The money will be expended

in part as follows: Building power plant, $134,964; machinery for electric power plant, $205,200; building electric power plant, $97,983; locomotive crane, $10,000; telephone and time system extension, $2000; underground conduit system, $10,000, and light plant extension, $5000.

WALLACOOCHEE, GA.—This town has prepared a bill to be introduced in the Georgia Legislature to authorize the issue of $10,000 bonds to be applied to public improvements, to consist of a new school and an electric light and water works system.

STERLING, ILL.—The Sterling Gas & Electric Light Company has offered for sale $50,000 five per cent. gold bonds, payable June 1, 1927.

GILLESPIE, ILL.—The Gillespie Electric Light Company has been incorporated, with a capital of $15,000. C. W. Smith is one of the incorporators.

MORRISONVILLE, ILL.—The Morrisonville Electric Company has been incorporated, with a capital stock of $6000, to operate a heat, light and power plant.

PARIS, ILL.—The City Gas & Electric Company, of Paris, has been incorporated with a capital of $150,000. Incorporators: A. J. Barber, W. J. Hunter and J. E. Parrish.

CHICAGO, ILL.—Bids will be received Aug. 31 by the Board of Trustees of the Sanitary District of Chicago for furnishing and installing turbine water wheels and governors.

JASPER, IND.—Electric light bonds to the amount of $12,000 have been sold.

SPENCER, IND.—There is a water power here which might be utilized for the generation of electricity. Mr. John Smith, R. F. D. No. 2, might be able to give more information on the subject.

CRAWFORDSVILLE, IND.—The Crawfordsville Electric Light & Power Company is changing its system from 133 cycles to 60 cycles. It is also increasing the size of its lines and installing larger units.

MARION, IND.—The municipal lighting plant is being changed over to the alternating current system, using Westinghouse alternator and series-enclosed arc lamps. The old apparatus will be eventually replaced by the series alternating system.

BOONE, IA.—T. L. Jones, City Clerk, writes that it is proposed to construct an electric light plant at a cost of $20,000.

SIOUX RAPIDS, IA.—The Council Committee will secure an offer for the purchase of the electric light plant, and also the cost of a new plant.

PEMBROKE, KY.—The Pembroke Water Power & Light Company has been incorporated with a capital of $10,000.

DANVILLE, KY.—The Council has authorized the sale of a franchise for electric lighting and street railway, including a contract for lighting the streets.

CUMBERLAND, MD.—The Potomac Light & Power Company has been incorporated, with a capital of $50,000, by G. T. Blackford, of Baltimore; Geo. M. Botchford, Wm. McL. Somerville and others.

ALPENA, MICH.—Electric light bonds to the amount of $100,000 have been sold.

KALAMAZOO, MICH.—The citizens have voted to issue $20,000 bonds to improve the electric light plant.

HOMER, MICH.—There is need here for an electric light plant. Mr. R. C. Smith, of this place, may give information.

ROGERS, MICH.—J. H. Roberts, of Alpena, has prepared plans and estimates for establishing an electric plant in Rogers for municipal and commercial lighting.

PLAINWELL, MICH.—The Brownell Electric Company is comtemplating installing a gasoline engine. It expects to put in about 50 horse-power to take care of part of the load.

BELLAIRE, MICH.—Henry Richardi, owner of the local power plant, is entertaining a proposition for the building of a 1000-hp plant here, furnishing a 24-hour alternating current service and supplying Charlevoix and other surrounding towns with current for lighting.

PLAINWELL, MICH.—It is stated that the J. F. Easley Milling Company has purchased property between the paper mills and the Plainwell power house, and is making preparations to utilize the power at this location and build an electric power house, at a probable cost of $15,000.

GRAND LEDGE, MICH.—The Grand Ledge Electric Power Company has been organized with $50,000 capital. Incorporators: E. C. Jarvis, of Lansing; H. Bootes and Glen D. Smith, of Jackson. The company proposes to utilize the water power and will either acquire the water privileges at Grand Ledge or build a dam near that city.

LITTLE FALLS, MINN.—The Council is considering the issue of $10,000 bonds for a lighting plant.

GRACEVILLE, MINN.—The city authorities are considering a proposition to install a new unit of about 50-kw capacity in the municipal plant. The present plant is much overloaded.

LEBANON, MO.—The Lebanon Electric & Power Company, of Lebanon, has been incorporated, with a capital of $2000. W. P. Simpson and W. I. Diffenderffer, of Lebanon, are among the stockholders.

OAKLAND, NEB.—The proposition to issue $7000 bonds for a lighting plant was carried at the election June 21.

FREMONT, NEB.—The City Council has authorized the city engineer to prepare plans and specifications for enlarging the city electric light station and addng new machinery.

RENO, NEV.—The Washoe Power & Development Company has decided to order all necessary equipment and machinery for its plant, so that it may be operated within 6 months.

CLAREMONT, N. H.—The Claremont Railway & Lighting Company contemplates the installation of a 350-hp boiler and a 2100-hp engine.

CARLSBAD, N. M.—Wm. A. Finley and Matthew S. Grover are among the directors of the Public Utilities Company, which proposes to construct water works and an electric light plant here.

MIDDLEVILLE, N. Y.—The Middleville Electric Light Company has been incorporated. Capital, $4000. Directors: Lewis H. Goodman, David E. Ford and Anna M. Goodman, of Middleville.

NEW YORK, N. Y.—The following are the bids opened recently by Wm. McAdoo, Police Commissioner, for material and labor required for furnishing electrical conductors and placing the same underground: The Okonite Company, $83,326; Safety Insulated Wire & Cable Company, $53,983; Standard Underground Cable Company, $74,945.

GREENSBORO, N. C.—The Cape Fear Power Company will soon move its offices from this place to Fayetteville, N. C.

SPENCER, N. C.—A large electric plant will, it is said, be erected here to drive the machinery of the Southern Railway shops.

CHARLOTTE, N. C.—The D. A. Tompkins Company, of Charlotte, is constructing an electric lighting plant at Davidson College, N. C. An arrangement may be made to light the town of Davidson.

OXFORD, N. C.—It is proposed to construct water works and an electric light plant at Oxford to cost $60,000. F. W. Siebert and E. C. Frost, of Salisbury, are interested. They will do the work themselves.

ELYRIA, OHIO.—The Dean Electric Company is preparing plans to double the capacity of its present plant.

COLDWATER, OHIO.—R. C. Steuve, of Wapakoneta, has secured a 10-year franchise to erect and operate an electric light plant.

SANDUSKY, OHIO.—A company is seeking a franchise to furnish electric light, heat and power. The matter is in the hands of the City Council. A. M. Wagner is City Clerk.

COLUMBUS, OHIO.—The Rocky River Water, Light & Power Company has been incorporated with a capital of $75,000. The incorporators are Christian Burkhardt, Chas. P. Corlett, E. H. Richards, E. Meunier and Robt. Fisher.

PATASKALA, OHIO.—A. G. Field, of Columbus, Ohio, is at the head of a company that proposes to put an electric light plant in Pataskala, which will also furnish illumination to Jersey, Summit Station, Etna, Kirkersville and Outville. Such a plant would cost something like $200,000.

KINGSTON, ONT.—In pursuance of an agreement with the Kingston Light, Heat & Power Company, the City of Kingston will take over the lighting plant of the company on August 1 next.

HAMILTON, ONT.—The Cataract Power Company enjoys a monopoly of the electrical business of this city and vicinity. It owns and operates the following concerns: The Hamilton Light & Cataract Company; the Cataract Power Company; the Hamilton Electric Light & Power Company; the Electric Power & Manufacturing Company; the Dundas Electric Company; the Hamilton Street Railway; the Hamilton Radial Electric Railway, and the Hamilton & Dundas Street Railway. The Cataract Company generates at present about 8000 horse-power at DeCew Falls, and is putting in a plant that will give it 40,000 horse-power in the course of two years. By next fall upwards of 26,000 horse-power will be available.

SILVERTON, ORE.—The Union Light & Power Company (A. B. Kurtz, superintendent, Silverton) will expend about $50,000 in improvements.

MARSHFIELD, ORE.—F. M. Friedberg is reported to have sold the plant of the Marshfield Light Company to C. F. MacKenzie, of Colfax, Wash. It is the intention of the new owner to double the capacity of the plant and make many other improvements.

MT. PLEASANT, PA.—The Hartigan Electric Light, Heat & Power Company, of Mt. Pleasant, has been incorporated, with a capital of $5000.

DANVILLE, PA.—The Rumsey Electric Mfg. Company, of Philadelphia, has secured the contract for constructing the municipal electric light plant for Danville at $15,000.

ST. LOUIS, QUE.—The council for the town of St. Louis has adopted a new contract with the Montreal Light, Heat & Power Company at $75 per lamp per year. The town's contracts with the Royal Electric Company and the Citizens' Light & Power Company were annulled.

NEWBERRY, S. C.—The council of Newberry has authorized the mayor to execute notes for $4700 to pay for a modern electric light plant. The council also voted to sell the present plant.

WILMOT, S. D.—The town is considering the construction of an electric light plant.

CLARKSVILLE, TENN.—The Queen City Electric Light & Power Company contemplates installing a 150-kw alternating current generator and an engine.

EL PASO, TEX.—The International Light & Power Company will install a 500-kw turbine.

HOLSTON, VA.—R. A. Ayers, of Big Stone Gap, writes that the Holston Industrial Company is to develop the water power at Holston Springs. A large building at Holston Springs will be utilized for manufacturing purposes when the water power is developed. The entire volume for Holston River will be run through a tunnel to turbines developing from 750 to 1000 horse-power. Final plans have yet been approved.

PORT ANGELES, WASH.—The Council has passed an ordinance providing for an issue of $14,000 bonds to continue the work of constructing an electric light plant.

RICHMOND, W. VA.—The Richmond Light & Power Company has been incorporated with a capital of $25,000. R. M. Dyer is president.

WAUSAU, WIS.—The Wausau Electric Company is building and equipping a new water power plant.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the San Francisco Railway Company, capitalized at $1,500,000, having for its object the construction and operation of two street railway lines. The directors are J. Walter Scott, of Oakland; W. E. Dennison, of San Mateo; W. A. Merralls, Alfred D. Bowen, of Petaluma; Lawrence T. Wagner, Louis A. Steiger and J. H. Goldman.

ALTON, ILL.—J. G. White & Co., of New York, have just placed a number of orders for material, equipment, etc., to be utilized in the construction of the Alton, Granite City & St. Louis Company's system. The American Steel & Wire branch of the United States Steel Corporation has been allotted the order for 27 miles of No. 000 trolley wire. The Mayer & Engtund Company, of Philadelphia, has secured the order for the rail bonds. The Lackawanna Steel Company got the order for rails. The Western Electric Company will supply the trolley poles.

CHICAGO, ILL.—The incorporation of the Chicago & Milwaukee Electric Railroad Company in the State of Wisconsin, as reported in many of the daily papers, means that the work of building the Chicago & Milwaukee Electric Railroad Company's line north from Waukegan is to be pushed by the company. The incorporation in Wisconsin is for the purpose of giving the corporation necessary legal rights in the State, particularly the right of eminent domain. The immediate object of the Wisconsin company is to build the small stretch of line from the State line near Winthrop Harbor, Ill., to Kenosha, Wis. The Illinois company is now building the line through Zion City, and it will be only a few months when the entire new line between Waukegan and Kenosha will be ready for operation. This will complete the chain of electric roads from Chicago to Milwaukee.

WABASH, IND.—It is stated that the sale of the Fort Wayne & Southwestern Interurban between Wabash & Fort Wayne, 45 miles, has been concluded. It is said by a director of the Fort Wayne & Wabash Valley that the company has bought the Southwestern, and only a few trifling formalities must be observed prior to the transfer, which will be made this month. The price is understood to have been about $1,000,000. The Southwestern will be merged with the Fort Wayne & Wabash Valley, with which it connects here, and through service established between Fort Wayne and Logansport.

VINITA, I. T.—W. T. Hutchings, of Muskogee, has incorporated a company of Pennsylvania capitalists to build an electric railway from Adair or Pryor Creek, in Indian Territory, to Blackwell, Okla. The company is to be capitalized at $2,000,000, and will pass through the oil belt of the two Territories.

TOPEKA, KAN.—Judge Pollock, of the United States District Court, has granted the application for a receiver for the Iola Electric Railway Company. The application was made by George W. Baumhoff, of St. Louis.

ALGIERS, LA.—A company has been organized, with a capitalization of $500,000, to construct and operate an electric railway to Bayou Barataria, La. It is proposed to build a large hotel, lay out parks and erect places for rest and recreation about 17 miles from New Orleans, on the Bayou. Besides handling passenger traffic to and from the Bayou, the line will be equipped for freight service. It is proposed to use the tracks of the Southern Pacific Company from Algiers to Harvey, and from thence going southward over the tracks of the electric road.

MARLBORO, MASS.—There is talk here of an organization of local business men to build a street railway line from here to Hudson and Maynard, and developing a pleasure resort at Fort Meadow Pond.

ROCKLAND, MASS.—The Plymouth County Street Railway Company, which plans to build an electric railway from Rockland to Kingston, has elected directors as follows: Charles F. Remington, of Woburn; George E. Morgan, of Burlington; Cass Levy, of Boston; Bradley S. Bryant, of Marshfield; Lot Phillips, of West Hanover; Walter Peterson, of Brant Rock, and W. S. Freeman, of Duxbury. The length of the road will be 31.25 miles, and the capital stock of the company is $125,000.

ALLEGAN, MICH.—The promoters of the Grand Rapids & South Haven Electric Railway have applied for a franchise to operate the road through Allegan.

SAGINAW, MICH.—The Flint & Saginaw Traction Company has filed articles of incorporation with the Secretary of State. It will build an electric railway from Flint to Saginaw.

MANKATO, MINN.—Thomas F. Deegan and Thomas F. Dalby, of Philadelphia, Pa., have submitted a proposition to the city for the construction of an electric railway here.

COLUMBUS, MISS.—J. T. Gunter, Mayor of Columbus, Miss., is anxious to negotiate with parties interested in establishing street car lines. The city is willing to give liberal franchises and encourage the project.

NEWARK, N. J.—The Consolidated Traction Company of New Jersey has declared a dividend of 1½ per cent. out of the rental received from the North Jersey Street Railway Company, payable July 15.

BROOKLYN, N. Y.—Public Works Commissioner Brackenridge, of Brooklyn, has granted permission to the Brooklyn Rapid Transit Company to lay tracks across the Brooklyn Bridge plaza and through Liberty Street to Fulton.

ALBANY, N. Y.—The directors of the United Traction Company have organized as follows: Chairman of executive committee, Robert C. Pruyn; president, John W. McNamara; vice-president, Francis H. Mann, Jr.; secretary, Charles G. Cleminshaw; treasurer, James McCredie; assistant treasurer, Hugh J. Collins; assistant secretary, Miss Julia Herrick.

XENIA, OHIO.—The bondholders of the Springfield & Xenia Traction Company have organized a new company to take over the property when it is sold under the present receivership.

CINCINNATI, OHIO.—Motion has been filed to remove the receivers of the Miami & Erie Transportation Company, Messrs. Schoepf and Richardson. They were appointed about a year ago.

COLUMBUS, OHIO.—The Columbus, Urbana & Western Railway Company has elected Charles Prior, of Cincinnati, president: Colin McDonald, secretary, and Gen. H. A. Axline, general traffic manager.

GENEVA, OHIO.—Homer Hood, of Toledo; L. H. Young and Marcus Westerman, of Youngstown, have been here investigating matters in regard to the electric railway which they propose to build from Geneva to the lake. They have a franchise.

MONTPELIER, OHIO.—J. M. Cummins has applied for a franchise through Montpelier, and is endeavoring to interest local people in the project. It is possible that the road will form a feeder for the Toledo & Western. At Bryan it will form a connection with the Toledo & Indiana.

CINCINNATI, OHIO.—Local interests are reported to be making an effort to secure the stock of the Toledo, Columbus, Springfield & Cincinnati Railroad Company and to build the road. Ellis Bartholomew, of Toledo, who was the original projector of the line, has not been able to finance the property.

CLEVELAND, OHIO.—The County Commissioners have granted a franchise to the Shaker Lakes & Boulevard Railway Company from the city limits to Warrensville Center. The line will provide a new entrance to the city for the Garrettsville division of the Eastern Ohio Traction Company. The interests in the new company are practically identical with those of the Eastern Ohio Traction Company.

TOLEDO, OHIO.—John A. Dunn, representing the Point Place Railway Company, has filed an acceptance of the franchise granted that company two weeks ago. Those interested in the company are Charles F. Yeslin, W. C. Gertz, Gus Lang and William R. Leflet. The Toledo Railways & Light Company will furnish the power for the line. The Toledo & Point Place Railway Company has been incorporated, with $10,000 capital stock. Incorporators: J. A. Dunn, W. R. Leflet, A. H. Lang, W. C. Gertz and C. F. Yeslin.

WAPAKONETA, OHIO.—The stockholders of the Springfield & Fort Wayne Electric Railway Company, at their annual meeting, elected the following officers, all residents of this county: W. H. Fledderjohann, president; Edwin Fledderjohann, first vice-president; Willis Armstrong, secretary; B. A. Fledderjohann, secretary; John H. Koenig, treasurer and general manager. The road between Decatur and Ft. Wayne, Ind., is rapidly nearing completion.

TOLEDO, OHIO.—John O. Zabel, of Monroe, general counsel for the Toledo & Jackson Electric Railway, and a stockholder in the Toledo, Ann Arbor & Detroit Electric Railway, says that the Ohio & Michigan and Toledo & Northwestern companies have been consolidated under the name of the Toledo, Ann Arbor & Detroit, and that the cars of the Toledo & Jackson line will run over the tracks of this company to Petersburg, Mich., where the line will branch off to Jackson. From Toledo to Petersburg the distance is 20 miles, and from that point to Jackson 50 miles more. The Patrick Hirsch Company has been awarded the contract for construction and equipment of the Toledo, Ann Arbor & Detroit line, 14 miles of which has been graded.

CLEARFIELD, PA.—Burgess Savage has approved the ordinance granting a franchise to the Clearfield & Curwensville Street Railway Company.

RIDGWAY, PA.—A charter has been issued at the State Department to the Elk Street Passenger Railway Company to construct an electric railway 17 miles long in Elk County, connecting Ridgway, Whistletown, Johnsonburg and St. Mary's. The capital is $102,000.

WESTCHESTER, PA.—Judge Edward C. Bradford, in the United States District Court at Wilmington, Del., it is reported, has appointed Thomas F. Bayard receiver of the Westchester, Kennett & Wilmington Electric Railway, on the application of Sterling & Company, made in behalf of themselves and other creditors.

MINERAL WELLS, TEX.—The City Council has granted a street railway franchise to Cicero Smith and E. E. Dismuke.

RICHMOND, VA.—The July coupons on the $3,000,000 consolidated gold 5s of the Richmond Passenger & Power Company, one of the underlying companies of the Virginia Passenger & Power Company, of Richmond, Va., of which Frank Jay Gould is first vice-president, were not paid July 1. The reason given for the non-payment of the coupons was that certain suits have been recently instituted against the company at Petersburg, Va., by George E. Fisher, which have seriously embarrassed the management in making its financial arrangements, which it is hoped will be but temporary.

CODY, WYO.—Plans are being considered for building an electric railway from Cody to Meetsetsee and Camp Kirwin. They call for the utilization of power generated by water from the Government Shoshone reservoir. Geo T. Beck is interested in the scheme.

NEW INCORPORATIONS.

THE MILLER ELECTRIC COMPANY has been incorporated at Newark, N. J., with a capital stock of $100,000. The incorporators are Alexander A. Miller, August J. Miller and Edward H. Scattergood.

THE WALWORTH & NEVILLE MANUFACTURING COMPANY, of Chicago, has secured a site in the Midway district, St. Paul, Minn., and expects to establish a plant for the manufacture of telephone and electrical apparatus.

THE ELECTRIC FILTER COMPANY has been incorporated at Youngstown, Ohio, by V. M. George, S. W. Carroll, John Goeppinger, Michael and Abe Livingstone. The capital stock is fixed at $10,000. The company was formed for the purpose of manufacturing and placing on the market a new water filter invented by Mr. George. The invention purifies water by means of electrolysis. The new company will organize and begin the manufacture of filters.

LEGAL.

INCANDESCENT LAMP SUITS.—The General Electric Company has brought two suits in the U. S. Circuit Court for the Northern District of Illinois against the Moline Incandescent Lamp Company for alleged infringement of U. S. Patents Nos. 537,693 of April 16, 1895, and No. 726,293 of April 28, 1903, respectively, covering a process of exhausting lamps, and known in the art as the "chemical exhaust" patents.

CLAIMS FOR LOSS BY DEATH.—In an action against the Delaware & Atlantic Telegraph & Telephone Company, the defendant's demurrer has been sustained by the Supreme Court of New Jersey. The syllabus by the court of the decision says: "A declaration in a suit by a father for injuries resulting in the death of his son, which fails to show any loss of services during the son's lifetime, and claims only for burial expenses and loss of services after the son's death, fails to show a cause of action."

RIGHT OF EMINENT DOMAIN.—In ruling favorably on an action in which the Rockingham County Light & Power Company was interested, the Supreme Court of New Hampshire said recently: "It is probable that in many cases the establishment and operation of electric railways for the accommodation of the public will depend upon the possibility of generating or collecting electricity at a low cost. A water power, or a port at which coal may be landed from seagoing vessels directly into the coal pockets of a power house, will render it possible to furnish electric railway facilities for public use at points situated many miles distant from the power house or port, that could not otherwise be furnished at all, or, at least, without much greater cost to the public. In such cases the imperativeness of the necessity attaches to the freedom of choice as to location, rather than to the proximity of a particular location to the railroad line. If land adjoining an electric railway may be taken for a power house—as to which there can be no doubt—no good reason is apparent why land at a distance may not be taken if the public good so requires. Of course, if land located at a distance may be taken for a power house, it must follow that necessary land or rights in land may be taken for constructing and maintaining a line of wires between the power house and the railway. As has already been intimated, like reasons may exist for having the power house of an electric light company, or other public service company, located at a distance from the place where the public service is rendered." The court held this to be broadly true even where the company had only such a public duty resting upon it indirectly.

EXCHANGE OF TELEPHONE FACILITIES.—The Court of Appeals of Kentucky has recently had before it the appeal in the denial of a writ of mandamus asked for by the Campbellsville Telephone Company to compel the Lebanon, Louisville & Lexington Telephone Company to receive messages over its wires and make all necessary connections for transmitting same over the lines of the relator. The refusal of the lower court is reversed on the relator's appeal in terms as follows: 1. Const. § 199, declares that telephone companies operating exchanges in different towns or cities shall receive and transmit each other's messages without unreasonable delay or discrimination. Two telephone companies extended their lines and connected them pursuant to a contract which required them to transmit each other's messages over the lines so extended and connected. Held, that the duration of the contract was the corporate existence of the two companies, and it was not determinable at the will of either. 2. Defendant telephone company and plaintiff telephone company contracted to connect their lines by extending them to a point midway between two cities, in one of which defendant maintained an exchange, and in the other of which plaintiff maintained an exchange; and it was provided that each company should have the right to send messages over the extended lines between the two cities, and, for more than eight years after the extension was made, messages originating elsewhere than in the two cities were received and passed over such lines. Held, that in view of the situation, and the practical construction given the contract by the parties, it should be construed as calling for the transmission of messages, irrespective of whether they originated in either of the two mentioned cities.

TRESPASS WITH TELEPHONE POLES. The Court of Civil Appeals of Texas has reversed the decision in favor of the plaintiff in the suit of E. T. Whiteman against the Southwestern Telegraph & Telephone Company, the question being one of trespass. The decision holds: 1. Where, pending a suit for trespass for erecting a telephone pole and stringing wires over plaintiff's property, the pole and wires were removed, whereupon plaintiff amended his petition alleging such removal, and charging that a large hole had been left where the pole stood, etc., the admission of evidence as to the difference in value of the land with and without the pole was error. 2. In an action for trespass in the erection of a telephone pole on plaintiff's property, plaintiff was not entitled to recover for loss of time expended in trying to get defendant to remove the pole. 3. Where no injury resulted to plaintiff from the stringing of wires on a telephone pole wrongfully planted on his property, and the wires were removed before trial of an action for trespass, plaintiff was not entitled to recover for the stringing of such wires under an allegation that they were strung so close to his house that they were dangerous to life, limb and security of the occupants thereof. 4. Where defendant placed a telephone pole in the corner of an unoccupied lot, at the intersection of two streets, not knowing that it was private property, the owner of such lot was not entitled to recover exemplary damages for such trespass. 5. Where defendant placed a telephone pole at the intersection of two streets, in the corner of an unoccupied lot, not knowing that it was plaintiff's property, and, after suit brought for the trespass, removed the pole and filled up the hole, leaving only a slight depression, caused by the settling of the earth, plaintiff was only entitled to recover what it would cost to fill up the depression and make the grass grow where the sod had been disturbed, and a nominal sum for the time the pole and wires remained on his premises. 6. Under such facts, a verdict awarding plaintiff $135 was excessive.

OBITUARY.

MR. A. F. DELAFIELD died at his home in Noroton, Conn., the past week. He was a descendant of an old New York family. His father was a surgeon in the War of 1812. His great-grandfather, William Floyd, was a signer of the Declaration of Independence. Mr. Delafield was born in New York in 1847. He married Miss Mary Anna Baker of New York. He was a member of the Institute of Electrical Engineers, the Society of the Sons of the Revolution and of the War of 1812 and of the Military Order of Foreign Wars.

PERSONAL.

MR. GEORGE H. MOSEMAN, the selling agent for the Weston instruments at Boston, has closed negotiations to represent the Cutter circuit breakers, etc., for all the New England States.

SIR W. H. PREECE, F. R. S., has returned home considerably benefitted by his trip to Egypt, and has resumed his practice in London as a consulting electrical engineer, in which his son is associated with him.

PROF. ARTHUR J. WOOD, of the electrical and mechanical department, Delaware College, Newark, Del., is to be married on July 26, at that place, to Miss Helen Margaretta Kerr, daughter of Mr. and Mrs. George Kerr.

MR. O. M. RAU, superintendent of the lighting department of the Milwaukee Electric Railway & Light Company, is receiving sympathy from his many friends on account of the loss of his wife, who died at their home in Milwaukee, July 8. Three children survive her.

MR. C. O. MAILLOUX returned a few days ago from Europe, but sailed again almost immediately. Although pressed with important business, he has given a good deal of time and attention abroad to the affairs of the St. Louis Electrical Congress, with excellent results.

MR. N. F. BRADY, treasurer of the New York Edison Company, sails for Europe this week, for a brief vacation. Mr. Brady is taking a deep interest and an active share in the Institute work connected with the reception committee in New York and the congress in St. Louis.

MR. H. C. SPAULDING has been appointed assistant sales manager by the Triumph Electric Company of Cincinnati, Ohio. This gentleman is widely known in the electric light and power field, and many friends will be gratified to note his abundant success in this new connection.

MR. W. D. SARGENT, vice-president of the New York & New Jersey Telephone Company, sailed on Wednesday of this week on the *Oscar Second*, for Europe with Mrs. Sargent. The party will land at Copenhagen and probably spend most of its time in Denmark, Sweden and Norway.

DR. OTTO FEUERLEIN, director of the incandescent lamp manufacturing department of the Siemens & Halske Company of Berlin, is on a visit to this country for the first time. He will make an inspection of the St. Louis Exposition, being interested also in other branches of electrical production.

MR. I. STERNFELD, manager of the Mexico City house of Braniff & Company, is now on a visit to the States. The Braniff firm are one of the largest handlers of electrical equipment, supplies, etc., in the Southern Republic. They take care of the Westinghouse business in that part of the world.

MR. B. L. FREEDY, who has been for many years manager of the St. Paul system of the Northwestern Telephone Exchange Company, has been promoted to the position of superintendent, with headquarters in Minneapolis, taking the place of the late W. A. Vail. Mr. R. H. Woolfolk, manager of the Stillwater exchange, has been appointed to succeed Mr. Freedy in the St. Paul office.

MR. A. L. WATERBURY, who was at one time first vice-president and general manager of the Citizens' Telephone Company of Houston, Tex., has accepted a position as general manager of the sales department of the American Conduit Company. Mr. Waterbury will have his headquarters at the Chicago office of the company, 1005-6 Manhattan Bldg.

DR. F. A. C. PERRINE has resigned as first vice-president of the Stanley Electric Manufacturing Company, to be succeeded by Mr. C. C. Chesney, formerly chief engineer. In regard to this interesting announcement, we learn that Dr. Perrine takes the step in order to secure the opportunity for following up some of his own technical affairs and for executing some important work in the field he has made so peculiarly his, namely, long-distance power transmission.

MR. LOUIS TERVEN, E. E., a graduate of the University of Wisconsin, has recently been appointed chief electrician of the Nernst Lamp Company, Pittsburg, Pa. Mr. Terven was for some time electrician of the United States Navy Yard, Port Royal, S. C., and resigned to enter the experimental laboratory of the Nernst Lamp Company. Later he was given charge of the chemical engineering department of this company. A second promotion in so short a time speaks well for his engineering ability.

MR. A. TEN BOSCH, of Rotterdam, Holland, is on a visit to this country, during which he hopes to inspect the more important electrical manufacturing works and central power stations. Mr. Ten Bosch is editor of *Het Vakblad*, an electro-technical journal of a popular character, and president of the Central Bureau for Technical Advice and Arbitration, a consulting engineering organization. He is also the author of a practical treatise on electrical engineering which has had a large sale in Holland.

DR. S. S. WHEELER, president of the Crocker-Wheeler Company, electrical manufacturer, sailed last Wednesday, July 13, with Mrs. Wheeler, on the new White Star liner *Baltic*. On the pier he said that he had planned a coaching trip in England; but early this spring Dr. Wheeler went on an automobile tour through the south of France and returned with the American patent rights of the celebrated electrical firm of Brown, Boveri & Cie., of Baden, Switzerland. Dr. Wheeler's commercial friends are beginning to take a lively interest in his holiday trips.

Trade Notes.

PASS & SEYMOUR, INC., Solvay, N. Y., report large sales of their new fuseless rosette for concealed work. They will gladly mail a sample to interested parties on receipt of request.

AUTOMATIC SWITCH COMPANY has removed from 106 Liberty Street, New York City, to its old address, 135 Liberty Street, where business will be continued under the management of David H. Darrin, president, and F. G. Townsend, secretary-treasurer.

NOARK FUSES.—The residence which Louis C. Tiffany, vice-president of Tiffany & Company, New York, is building at Cold Spring Harbor, N. Y., is equipped throughout with H. W. Johns-Manville Company's "Noark" fuses, also with its 85 per cent. magnesia pipe covering.

THE EMPIRE ELECTRIC SUPPLY COMPANY, 55 West Jackson Boulevard, Chicago, reports a large sale of its incandescent lamps, which, it states, are giving more than ordinary satisfaction. It is prepared to make prompt shipments of these and other specialties and supplies.

THE UNITED ELECTRIC COMPANY, of San Francisco, announces that it has a large and varied stock of second-hand machinery in San Francisco for immediate delivery. The company also conducts a general supply, construction and repair business, making a specialty of motor and generator repairs.

STOW MULTI-SPEED MOTORS are the subject of Bulletin 52, issued by the Stow Manufacturing Company, Binghamton, N. Y. It is well illustrated and contains many exemplifications of the use of these ingenious machines, whether of the stationary or of the portable type. A list is given containing the names of some of the users of these motors.

NORTHERN ELECTRICAL MFG. COMPANY, Madison, Wis., has issued Leaflet No. 131, devoted to the subject of fans and ventilation. Its four pages show a number of Northern motors direct-connected to various types of such machinery, as, for example, Connersville cupola blower, Buffalo forge blower, Blackman fan, Bayley fan, American blower fan, etc.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued a new catalogue, No. 19043, covering its circuit breakers. It is selling the trade large numbers of its FSH and FDH types, no voltage and overload current circuit breakers, which are used to operate large motors, etc. Specifications covering this type of circuit breaker are printed in detail in this catalogue.

CROCKER-WHEELER COMPANY has issued a very handsome bulletin entitled "The Power of the Intramural," printed at the Matthews-Northrup works, Buffalo, N. Y., and containing a map in colors of the St. Louis Exposition. The company is using it to advertise its principal exhibit at St. Louis, namely, seven railway type generators, which are elaborately set forth and well described.

FRANK H. STEWART ELECTRIC COMPANY has been formed at Philadelphia, Pa., and has bought out the well-known electrical supply and manufacturing business built up by Mr. Frank H. Stewart, who becomes the president of the new concern, and who will have associated with him those who were long connected with the old firm. The new company is modestly capitalized with a capital stock of $50,000 preferred stock and $50,000 common.

PROMETHEUS ELECTRIC HEATING.—Mr. Max Loewenthal, electrical engineer of the Prometheus Electric Heating Company, New York, has returned recently from a New England trip. He was successful in closing several important contracts. The apparatus is now being displayed in the splendid show room of the Boston Edison Company, and is also on view and sale at the department store of the Jordan Marsh Company.

NILES-BEMENT-POND COMPANY, 136 Liberty Street, New York City, has issued a neat and handsome number of its "Progress Reporter," devoted specially to the Louisiana Purchase Exposition and its display in the Palace of Machinery, where it occupies a large block of central space, filled very attractively with machine tools, all entirely new or embodying modifications of older patterns. All the larger machines, it is worthy of note, are driven by direct-connected motors.

TOLL-LINE SWITCHBOARDS.—The Conn. Tel. & Elec. Company, of Meriden, Conn., has placed on the market several new styles of toll-line switchboards which are especially designed for heavily loaded lines. This company has realized the demand for a thoroughly reliable toll-line board and the sale has been very large on this material. A bulletin has been issued which will be mailed on request, describing this apparatus. The company has also issued a new and enlarged catalogue No. 8, which will be sent for the asking.

MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt Street, New York City, has just issued Catalogue No. 18, with net trade price list. It is a portly volume of no less than 640 pages, and is in itself a compendium of the electrical arts, every branch of which finds a place. Details and illustrations are given copiously of all classes of goods, a great many of which are of the company's own manufacture and are its well-known exclusive specialties. At the end of the book are views of the headquarters in New York and Chicago and of the big factory in Jersey City, with 100,000 square feet, where 500 employes make nearly 1000 different electrical articles.

CROSS OIL FILTERS.—Mr. W. F. Warden, president and general manager of the Burt Mfg. Company, of Akron, Ohio, has just returned from an extended business and pleasure trip abroad, having visited England, France, Germany, Switzerland, Norway, Sweden, Italy and Spain, calling upon the regular agencies of his company and establishng new ones. He reports a profitable trip, having formed many new and desirable connections while abroad, in addition to looking after the stock of the old agencies. Cross oil filters are known in every country under the sun where lubricating oil is known. While in England, Mr. Warden personally sold one of the large size Cross oil filters to Bryant & May, the English representatives of the Diamond Match Company. Mr. Warden reports that he feels greatly benefitted physically by his trip and is prepared to take hold of the business again with renewed interest and energy. While in London he secured an order from his British agents for 150 oil filters and exhaust heads, which is the largest single order for goods of this kind that has ever been given.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 12, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

764,588. CROSSING SIGNAL FOR RAILWAYS; Charles R. Hill, Toledo, Ohio. App. filed Aug. 12, 1901. Details of a railway signal adapted to operate upon the approach of a train and not when the train recedes.

764,592. SYSTEM FOR THE CONTROL OF ELECTRIC FURNACES; Woolsey McA. Johnson, Laharpe, Kan. App. filed Nov. 16, 1903. The system comprises a pyrometer, an indicating device connected therewith, a regulating device for the furnace circuit, and means connected with the indicating device for operating the regulating device.

764,595. METHOD OF CONVERTING THE ENERGY OF FUEL INTO ELECTRICAL ENERGY; Hugo Jone,, Chicago, Ill. App. filed Nov. 7, 1901. The method consists in first combining a metal, the oxid of which yields chiefly carbon dioxid in addition to the metal in its reduction by carbon, as the positive plate with an alkali as the electrolyte in a galvanic cell, generating electrical energy by oxidation of the metal, and then reducing that battery product which contains the metal oxidized in the battery reaction, to the metal by means of the oxidation energy of fuel, and repeating the oxidation of the metal with generation of electrical energy.

764,608. ELECTROMAGNET; David L. Lindquist, Yonkers, N. Y. App. filed March 8, 1904. The magnet is adapted to be energized by an alternating current and when so energized to attract its armature and hold the same in position by substantially constant pull and without chattering.

764,633. SPEED CONTROLLER FOR CAR HAULS; Lewis J. Robb, Pittsburg, and Ford W. Harris, Allegheny, Pa. App. filed Sept. 15, 1903. An electric generator is driven from the chain or cable and in the circuit of the generator is placed a suitable resistance so as to impose a load on the generator and thus automatically control the speed of the chain or cable.

764,649. AUTOMATIC MOTOR CONTROLLER; George H. Whittingham, New York, N. Y. App. filed Oct. 20, 1902. A controller designed to automatically remove from the circuit of the motor armature successive portions of resistance, whereby following upon the simple throwing of a switch the motor will be automatically started. Means are provided whereby the speed at which the resistance-cutting-out devices are to be operated may be regulated and whereby a definite time interval may be provided for between the cutting-out of the successive resistance coils.

764,651. RHEOSTAT; Charles Wirt, Philadelphia, Pa. App. filed Nov. 6, 1903. The resistance is located within a cylindrical shell of sheet steel, and consists of a strip or plate laid against the inner surface of the shell with the thinnest possible interposed insulation. The contact sections bear directly against the resistance and means are provided for producing and sustaining a circular pressure between the adjacent sections.

764,674. ELECTRICAL HEATER; Lovell B. Pemberton, Redondo, Cal. App. filed Jan. 4, 1904. Two cylindrical coils are provided located one within the other, one being a seamless metal pipe carrying water to be heated, and the other a conducting wire adapted to carry a current of electricity, together with means for confining the distribution of the heat from the conducting wire to the water and for imparting the heat to all parts of the water simultaneously.

764,688. TROLLEY; George E. Smith, Exeter, N. H. App. filed June 5, 1903. Details.

764,752. APPARATUS FOR TELEPHONE SWITCHBOARDS; Frank R. McBerty, Evanston, Ill. App. filed Oct. 24, 1902. The purpose of the invention is to provide means whereby the failure of an operator at the central station to perform certain required acts at the proper time, will result in the actuation of a signal or alarm.

764,792. AUTOMATIC ELECTRIC LIGHT FOR TELEPHONE BOOTHS; John L. Bolan, South Connellsville, Pa. App. filed Aug. 23, 1902. When the operator actuates the bell, the vibrations of the knocker will actuate the mechanism for completing the circuit and thereby light the electric light within the booth.

764,807. TROLLEY RETRACTOR; Richard H. Ham, Stockport, N. Y. App. filed Sept. 29, 1903. Details of a trolley retractor in which the retaining socket of the catcher is so mounted that when a pull is exerted on the latter, the socket will be freed from its locked position and caused to rotate or move in approximate parallelism to the dash, so as to exert a downward pull on the trolley rope.

764,812. ELECTRICAL INSULATOR; Charles W. Jefferson, Schenectady, N. Y. App. filed Dec. 18, 1902. The invention consists of a separate elementary scale of mica, toughened by a coating of dried shellac, the said scale being adapted to be used as a unit in building up an insulator.

764,813. ELECTRIC BATTERY; Pierre J. Kamperdyk, New York, N. Y. App. filed Dec. 26, 1902. The negative pole electrode is made of a flat plate of zinc having a plurality of conducting wires, protected against corrosion, inclosed therein with their ends projecting from the upper edge thereof, the said wires extending both longitudinally and transversely of the plate and serving to maintain the shape of said plate when partially exhausted by the action of the exciting agent, and as conductors connecting the several portions when said plate is fractured or partially disintegrated, the said ends serving as a negative pole.

764,814. ELECTRIC MEASURING INSTRUMENT; Arthur A. Kent, Philadelphia, Pa. App. filed Nov. 21, 1903. The instrument is designed for the measurement of both the potential and strength of an electric current, means being provided for regulating the strength and position of the magnetic field so that the instrument may be readily calibrated and adjusted. A permanent magnet is employed, and between its poles is pivoted an armature to which an indicator is attached. The magnet is also provided with a secondary projecting core which carries the fine and coarse wire coils for the volt and ampere meters, respectively, and which serve to distort the permanent magnetic field to give the readings. A switch is also provided for throwing either one of the coils into operation.

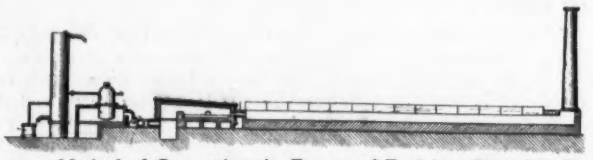
764,815. TELEGRAPHIC TRANSMITTER; William E. Miller, Sr., St. Louis, Mo. App. filed Feb. 19, 1904. Details of a mechanism whereby a succession of dots may be automatically sent and whereby the operator may get

relief from the strain resulting from the continued muscular exertion of one character.

764,826. GALVANIC BATTERY; Charles B. Schoenmehl, Waterbury, Conn. App. filed Nov. 2, 1900. An open circuit battery in which is employed a basket, circular in cross-section, for holding a depolarizer having exterior, perforated, tapering side walls producing a conical-like receptacle, larger at its top end than the other and a removable cover for one of said ends.

764,827. GALVANIC BATTERY; Charles B. Schoenmehl, Waterbury, Conn. App. filed July 23, 1901. The battery includes a depolarizer-receptacle comprising an annular perforated basket, broader through the top than the bottom, a central chamber within the basket having perforated side walls and openings in the bottom of the basket to insure access therethrough of the solution.

764,829. INCANDESCENT LAMP HOLDER; Walter H. Scott, Chicago, Ill. App. filed Feb. 2, 1904. The purpose of the invention is to provide against unauthorized detachment of the lamp, so as to prevent theft. A lock is employed which normally permits the free rotation of a lamp within its socket, the attaching member of the socket turning with the lamp, and a detent being provided which may be thrown by means of a key into engagement with the attaching member, so as to lock it against rotation, thereby permitting the lamp to be unscrewed.



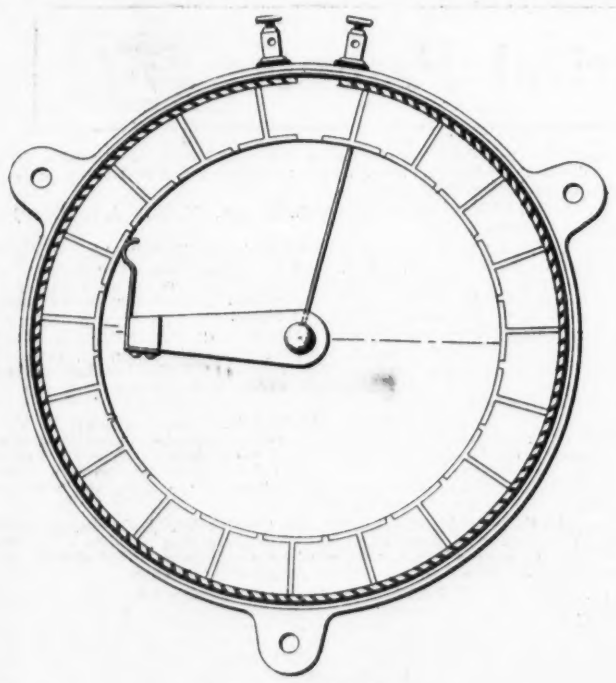
764,595.—Method of Converting the Energy of Fuel into Electrical Energy.

764,836. ELECTRO FLUID PRESSURE SWITCHING MECHANISM; Walter J. Bell, Los Angeles, Cal. App. filed Aug. 6, 1903. The mechanism disclosed comprises a switch element, a double-acting pump for moving the switch element, solenoids for reciprocating the pump piston, and a pole changer for said solenoids consisting of a contact carried by a moving part, spring contacts each electrically connected with one of said solenoids and alternately engaged by said contact and an inclined bar between the spring contacts for deflecting the contact whereby the latter is snapped from one contact to the other at the ends of its movements.

764,852. PUMP CONTROLLER; William F. Irish, East Orange, N. J. App. filed May 6, 1903. The invention consists of an electric motor for operating a pump, a receptacle supplied with fluid by the pump, a piston operated by the fluid supply of the pump, an electro-magnet connected in shunt to the motor, a switch controlled by the fluid in the receptacle and a motor switch controlled by both the piston and the switch.

764,856. ELECTRIC RAILWAY; Timothy Mahoney, San Francisco, Cal. App. filed Aug. 4, 1903. The purpose of the invention is to provide a switch box and operating means therefor carried by the car, the invention consisting of a trolley wheel having a magnetizable rim and a series of readily magnetizable spokes inclosed thereby, the series of spokes being helically wound by a continuous conductor to form a single magnet whose opposite poles are at the center and periphery of the wheel.

764,911. ELECTRIC CLOCK; Henri Campiche, Geneva, Switzerland. A filed Feb. 25, 1904. The clock of this patent is intended for marine purposes and consists of a balance wheel, an escapement wheel, an electro-magnet, means actuated by energizing the magnet to give an impulse to the balance wheel, means actuated by the oscillation of the balance wheel to rotate the escapement wheel, means for preventing more than a given movement at one time to the escapement wheel, means for closing th circuit to the electro-magnet intermittently by means of the escapement wheel, and means for closing a distributing circuit to other electric clocks.



764,651.—Rheostat.

764,915. TROLLEY GUARD; Anton Christensen, Chicago, Ill. App. filed April 29, 1904. Details.

764,942. ELECTRIC RAILWAY SYSTEM; Wilber E. Guthrie, Chambersburg, Pa. App. filed Feb. 5, 1904. Details of a system which dispenses with the use of a continuous live trolley wire, either overhead or underground, and which employs a feed wire buried in the roadbed and connecting at intervals with a series of upwardly projecting contacts, adapted to make contact with a long shoe carried by the car and of such length as to bridge the space between any two contacts.

764,963. TOLL REGISTER FOR TELEPHONES AND AN ELECTRICAL SYSTEM FOR CONTROLLING THE SAME; Harold D. Stroud, Chicago, Ill. App. filed June 4, 1902. Details of a construction by which, while the subscriber performs the operation of recording a call or registers the toll, the operator at the central exchange is enabled to count back or throw off the toll, or call registered, in the event that she should be unable to give the proper connection and the subscriber should accordingly not be charged with the call.

764,994. ELECTRIC ROASTING-OVEN; Georges Edmond Dutertre, Levallois-Perret, France. App. filed Oct. 7, 1903.

765,001. PROCESS OF MANUFACTURING VANADIUM AND ITS ALLOYS; Gustave Gin, Paris, France. App. filed May 9, 1903. The process consists in subjecting an anode made of an agglomerated mixture of carbon and vanadium oxid to electrolytic action in a fused bath consisting of calcium fluorid and a fluorid of the metal with which the metal is to be alloyed, introducing the metal with which the vanadium is to be alloyed, in a metallic state, in proximity to the cathode, and tapping the resultant alloy product.

765,003. TROLLEY POLE HEAD; John E. Greenwood, Utica, N. Y. App. filed Aug. 29, 1903. The trolley pole has a coiled spring secured to it at a point intermediate its ends, collectors are provided on the spring and means are provided for engaging the ends of the spring to maintain it in horizontal position.

765,004. TROLLEY POLE HEAD; John E. Greenwood, Utica, N. Y. App. filed Aug. 29, 1903. The trolley pole has a cap-piece pivotally mounted thereon; a leaf spring is supported on edge on the cap-piece and collectors are arranged in tandem on the spring.

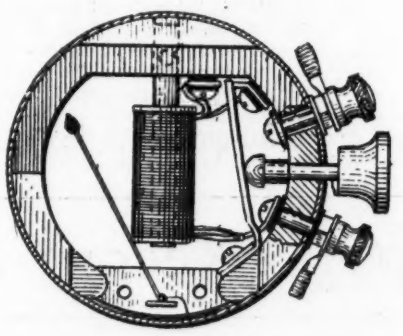
765,013. MAGNETIC ORE SEPARATOR; Frederick J. King, Croydon, England. App. filed March 31, 1902. The invention comprises a set of magnet bars for sorting the material and another set of curved magnet bars at right angles to the first and overlapping the lower end of the first set for separating the sorted material.

765,030. COMBINED STARTER AND REGULATOR FOR ELECTRIC MOTORS; Edward T. Moore, Newburg, N. Y. App. filed Nov. 10, 1903. Interposed between the motor and the apparatus to be actuated is a combined starter and regulator comprising a resistance box and an arm actuated by the apparatus in accordance with the amount of work required of it to put into the circuit more or less resistance and thereby increase or decrease the speed of the motor.

765,037. ANNUNCIATOR; Patrick O'Connor, Augusta, Me. App. filed Feb. 28, 1903. Details.

765,039. PRESSURE CONTROLLED ELECTRIC SWITCH; William J. Pugh, Davenport, Ia. App. filed Nov. 16, 1903. The invention consists of an electric motor, air compressors actuated thereby and a pressure gauge having an indicating finger mounted on a rotable shaft, with a contact finger and a contact spring on said shaft, a contact piece adapted to be engaged by said finger, and an electro-magnet adapted to be engaged by the spring, said magnet being included in the electric circuit.

765,040. PRESSURE CONTROLLED ELECTRIC SWITCH; William J. Pugh, Davenport, Ia. App. filed Dec. 24, 1903. A switch lever is provided, adapted to engage a contact, in connection with a spring for rocking the lever away from the contact, a pressure-controlled diaphragm, a spring-pressed plunger engaged therewith, a device attached to the plunger adapted to engage the switch lever and forcibly close the switch, a spring catch adapted to lock the switch in closed position and a device operated by the plunger to disengage the catch from the switch after the switch-closing device has been moved away from the switch.



764,814.—Electric Measuring Instrument.

765,060. STORAGE BATTERY; Theodore A. Willard, Cleveland, Ohio. App. filed Aug. 13, 1903. The invention resides in a sheath enveloping the plate or electrode, having cone-shaped perforations formed by blowing the surface of the sheath full of conelike perforations and grinding off the points.

765,064. TELEPHONE DESK SET; Peter C. Burns, Chicago, Ill. App. filed March 2, 1903. A single screw holds all the different parts together and is accessible at the bottom of the base and the induction coil is included within the base instead of being mounted upon a separate support.

765,075. TROLLEY HARP; Charles L. Hooper, Rochester, N. Y. App. filed Dec. 15, 1903. Details.

765,078. ASYNCHRONOUS MOTOR; Paul Jigouzo, Vanves, France. App. filed Dec. 1, 1902. A bell is secured to a rotatable shaft and carries an armature, and an inductor is arranged within the bell and provided with notches arranged in pairs, the notches of each pair being parallel with each other, with windings engaging the notches.

765,082. STORAGE BATTERY; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 9, 1902. Both the positive and negative electrodes are contained within one containing frame provided with an inlet for the electrolyte and a porous support for the conducting and active material for each electrode.

765,136. OVERHEAD CONDUCTOR POINT OPERATING MECHANISM; Charles G. Goord, Brighton, England. App. filed Sept. 17, 1903. The mechanism comprises a switch operated by the rail point, a magnet upon the overhead frog, an electric circuit including the magnet and the switch, and conductor connections operated by the magnet.

765,137. TROLLEY FORK; Charles G. Hartman, Glens Falls, N. Y. App. filed Dec. 21, 1903. The trolley fork has a disk mounted thereon and means are provided on the disk for temporarily holding the pin of the trolley wheel, in connection with means on the fork for permanently holding the pin and means for bringing the two into registering position.

765,142. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed Aug. 27, 1903. The invention resides in improvements in the switchboard and dispenses with the usual cord connections, the same consisting of line terminals, plugs for the terminals, movable contacts having portions adjacent to each of said plugs and adapted to be connected with any one of said plugs and means for preventing all but a single plug from engaging one of the contacts not in use.

765,150. ELECTROTHERAPEUTIC INSTRUMENT; James W. Shryock, Pueblo, Colo. App. filed Feb. 27, 1904. Details.